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TRANSACTIONS

OF THE

New England

COTTON MANUFACTURERS' ASSOCIATION.

Founded April 20, 1865. Incorporated Dec. 1, 1894.

NO. 74.

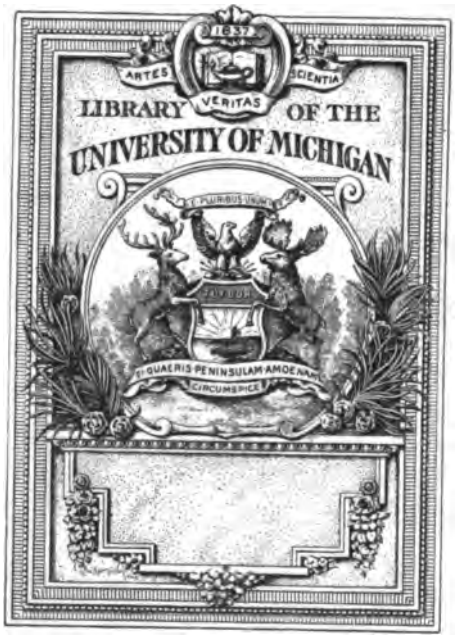
ANNUAL MEETING.

Held in Chipman Hall, 88 Tremont Street, Boston, Mass.

APRIL 22-23, 1903.

Office of the Association:
Room 57, International Trust Building, 45 Milk Street,
Corner of Devonshire St., Boston, Mass.

WALTHAM, MASS.:
PRESS OF E. L. BARRY,
1903



THE GIFT OF

Association.

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1550
. N2

NEW ENGLAND

Cotton Manufacturers' Association.

Proposal for

Membership of

Notice to Members.

To make the Cotton Manufacturers' Association an absolutely representative body it must include as many as possible of those who are eligible for membership. It has been found that many who were eligible and desired to join had not done so because not invited. It is hoped that every member will present the matter to non-members among his associates. The accompanying blank proposition for membership can be detached from the cover at the row of perforations.

NEW ENGLAND

Cotton Manufacturers' Association.

Proposal for

. . . . . .

Membership of

. . . . . .

Application Received

. . . . . 190 .

Action by Board of Government, ... *favorable.*

. . . . . 190 .

Voted by the Association, ... *elected.*

. . . . . 190 .

New England
Cotton Manufacturers' Association.

Room 57, International Trust Building,

45 MILK STREET,

BOSTON, MASS.

PROPOSAL FOR MEMBERSHIP.

(When filled out, to be mailed to the Secretary, P. O. Box 3672, Boston, Mass., in time for action by the Board of Government, at least one week before a meeting of the Association.)

Mr. .....

Position, ...

P. O. Address, ...

is proposed for ..... *membership in the* NEW ENGLAND COTTON
active or associate

MANUFACTURERS' ASSOCIATION *by* .....
signature of member proposing candidate.

a member of the Association.

Experience of Applicant, (Please state, in full, particulars of detail, giving names, dates, and nature of work, as fully as convenient.)

.....

.....

.....

.....

.....

.....

.....

.....

.....

The undersigned certifies that the above statements are correct, and agrees that, if elected to the Association, he will be governed by its rules as long as his connection with it shall continue.

Date, ... 190 .

.....
signature of candidate.

AMBROSE EASTMAN.

TRANSACTIONS

OF THE

New England

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Room 57, International Trust Building, 45 Milk Street,
Corner of Devonshire St., Boston, Mass.

WALTHAM, MASS.:
PRESS OF E. L. BARRY,
1903.

ENTERED ACCORDING TO ACT OF CONGRESS
IN THE YEAR 1903
BY THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,
IN THE OFFICE OF THE LIBRARIAN OF CONGRESS
AT WASHINGTON.

By vote of the Board of Government, the price of the *Transactions* is $5.00 per copy to non-members. The price of this issue and the one previous is $1.00 each to members, and the prices of copies previous to Volume 61, is 50 cents to members, but each member is entitled to a copy as a part of the privilege of membership.

CHARTER.

No. 6091.

Commonwealth of Massachusetts.

BE IT KNOWN, That whereas, EDWARD W. THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN have associated themselves with the intention of forming a corporation under the name of the NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION, for the purpose of encouraging scientific investigation and experiment as to the methods of manufacturing cotton; collecting and imparting information relating to this industry, promoting social intercourse among its members; and establishing and maintaining a library of works on textiles in the city of Boston, and have complied with the provisions of the Statutes of this Commonwealth in such case made and provided, as appears from the certificate of the President, Treasurer and Directors of said corporation, duly approved by the Commissioner of Corporations, and recorded in this office.

Now, Therefore, I, WILLIAM M. OLIN, Secretary of the Commonwealth of Massachusetts, do hereby certify that said EDWARD W THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN, their associates and successors, are legally organized and established as and are hereby made an existing corporation under the name of the

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,

with the powers, rights and privileges, and subject to the limitations, duties and restrictions which by law appertain thereto.

Seal of the Commonwealth of Massachusetts.

Witness my official signature hereunto subscribed, and the seal of the Commonwealth of Massachusetts hereunto affixed this first day of December, in the year of our Lord one thousand eight hundred and ninety-four.

WILLIAM M. OLIN,

Secretary of the Commonwealth.

197074

Commonwealth of Massachusetts.

(Acts of 1895, Chap. 163.)

AN ACT TO AUTHORIZE THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION TO HOLD ITS MEETINGS WITHOUT THE COMMONWEALTH.

Be it enacted, etc., as follows:

SECTION 1. The New England Cotton Manufacturers' Association is hereby authorized to hold its meetings in any state or territory of the United States and in the District of Columbia; provided, however, that its annual meeting shall be held in this Commonwealth at least once in five years.

SECT. 2. This act shall take effect upon its passage. [Approved March 23, 1895.]

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION.

FOUNDED APRIL 20, 1865.

INCORPORATED DECEMBER 1, 1894.

CONSTITUTION AND BY-LAWS.

ACTIVE MEMBERS.

ARTICLE 1. Any person who is actively engaged as President, Treasurer, Agent, Superintendent or Manager in the manufacture, printing or finishing of cottons shall be eligible for active membership.

ELECTION OF MEMBERS.

ARTICLE 2. All nominations for membership shall be made in writing, at least one week before the date of any regular meeting, and shall be considered by the Board of Government, and reported to the meeting, favorably or adversely, for the action of the Association. *Provided*, that in case the Board shall decide to report adversely upon any nomination, the member who shall have made it shall be informed of the intention so to report, in order that he may have an opportunity to withdraw the name. Upon such report active members may be admitted, if they obtain a majority of votes of the members present and voting therefor, by acceptance in writing, and paying an admission fee of ten dollars, and maintaining their membership by the payment of an annual assessment not exceeding ten dollars.* Any member failing to pay two successive assessments shall cease to be a member at the end of six months from the date when such second assessment shall become due. Any member may withdraw from the Association upon payment of all arrearages, first giving notice of his intention so to do, in writing, to the Secretary, and the Board of Government may accept such resignation; and any member may be expelled for cause,

* This assessment has never exceeded five dollars for active members and ten dollars for associate members.

at any regular meeting, two-thirds of the members present voting therefor.

ASSOCIATE MEMBERS.

ARTICLE 3. Persons engaged in the manufacture of cotton or cotton fabrics, or the manufacture of textile machinery, or industries kindred to the cotton manufacture, may become associate members of the Association. The methods of application, nomination, election and withdrawal from the Association being under the same conditions as those provided for active members in Article 2, excepting that this class of membership does not carry with it the privilege of voting or speaking, except by permission from the Board of Government or a vote of the Association to allow permission.

The initiation fee for associate members shall be twenty-five dollars, and the annual assessment shall be double the sum annually voted for active members.

Associate members may be expelled by a majority vote of the Board of Government.

HONORARY MEMBERS.

ARTICLE 4. Honorary members may be elected, when recommended by the Board of Government, at any regular meeting of the Association, who shall be enrolled as such, and shall be entitled to attend the meetings of the Association and participate in its proceedings, without the right to vote. They shall not be subject to payment of admission fees or assessments. No person actively engaged in cotton manufacture shall be eligible to honorary membership.

ARTICLE 5. It shall be the duty of all members of the Association to make returns to the Secretary of such statistics as may be called for by him, under the direction of any committee duly appointed for the collection of statistics, when not incompatible with private interests.

OFFICERS.

ARTICLE 6. The officers of this Association shall be a President, two Vice-Presidents, six Directors, a Treasurer, Secretary, and Auditor of Accounts.

ELECTION OF OFFICERS.

ARTICLE 7. At each annual meeting there shall be chosen by ballot a President, two Vice-Presidents and two Directors; the President and Vice-Presidents to serve one year, and the two Directors shall be chosen for terms of three years.

DUTIES OF OFFICERS.

ARTICLE 8. The President, or in his absence the senior Vice-President present, shall preside at all meetings of the Association and of the Board of Government. All officers shall hold their respective offices until their successors shall be chosen and accept their positions.

ARTICLE 9. The President, Vice-Presidents and Directors shall constitute a Board of Government, and have under their care and direction all matters pertaining to the management of the Association; and five of their number shall constitute a quorum for the transaction of business. Meetings of the board may be called by the President, at such time and place as he may deem expedient, giving each member a written or printed notice of the same at least five days before the day of meeting. At their first meeting the board shall elect a Treasurer, Secretary, and Auditor of Accounts for the year ensuing, and fix the amount of compensation of the Secretary. All vacancies in their board occasioned by death or resignation shall be filled by the board; and the persons so elected shall hold their offices until the next annual meeting. The board may, from time to time, as they shall deem expedient, appoint committees, from among their own board or from the members at large, to collect statistical information, examine new inventions or processes in manufacturing goods, as also to prepare essays on subjects of interest to the Association.

ARTICLE 10. The Treasurer shall keep a book in which all receipts and payments of money shall be entered, collect all moneys due the Association, and disburse the same upon the written order of the Board of Government. At the annual meeting in each year he shall make an exhibit of his accounts, or oftener if the Board of Government require it. He shall notify the members of assessments voted, and cause them to be collected in a reasonable time.

ARTICLE 11. The Secretary shall attend all meetings of the Association and of the Board of Government, and keep accurate records of

their doings. In the absence of the Secretary at any meeting, a Secretary *pro tem.* may be appointed by the presiding officer, who shall be sworn to do all things, while in office, required of the Secretary.

ARTICLE 12. The Auditor shall examine the accounts of the Treasurer annually, and report at each meeting the state of the finances.

MEETINGS.

ARTICLE 13. The annual meeting of the members of the Association shall be held on the last Wednesday of April, or at such other time, and at such hour and place as the Board of Government may appoint. There shall also be a semi-annual meeting of the Association on the last Wednesday of October, in each and every year, or at such other time, and at such place and hour as the Board of Government may appoint.

Special meetings may be called by the Board of Government whenever they deem it expedient, or upon the written application of any ten members, made to the Secretary.

ARTICLE 14. All meetings of the members of the Association shall be in pursuance of a written or printed notice, addressed to each member, with the name of the President or Secretary attached thereto, and deposited in the Post Office ten days at least before the day of meeting, specifying the time and place of meeting; and at all such meetings fifteen members shall constitute a quorum for the transaction of business.

ARTICLE 15. Amendments to the By-Laws may be made at any stated meeting of the Association by a two-thirds vote; *provided*, notice of such proposed amendment be given in writing at a previous meeting, and also notice be given to each member by the Secretary, of the pendency of such amendment, ten days at least before any such meeting.

BOARD OF GOVERNMENT.

1903.

PRESIDENT.

HERBERT E. WALMSLEY, . . . New Bedford, Mass.

VICE-PRESIDENTS.

WILLIAM D. HARTSHORNE, . . Lawrence, Mass.
JAMES R. MacCOLL, ... Pawtucket, R. I.

DIRECTORS.

GEORGE P. GRANT, Jr., . . . Fitchburg, Mass.
PHILIP A. MATHEWSON, . . . Fall River, Mass.
J. R. MONTGOMERY, ... Windsor Locks, Conn
WILLIAM D. PENNELL, ... Lewiston, Me.
W. B. SMITH WHALEY, ... Columbia, S. C.
GEORGE F. WHITTEN, . . . Manchester, N. H.

AUDITOR.

C. E. ROBERTS, ... Boston, Mass.

SECRETARY AND TREASURER.

C. J. H. WOODBURY, P. O. Box 3672, Boston, Mass.

OFFICE OF THE ASSOCIATION:

Room 57, International Trust Building, 45 Milk Street, Corner of Devonshire Street, Boston, Mass.

OFFICERS OF THE ASSOCIATION,

FROM THE FIRST ORGANIZATION.

PRESIDENTS.

Ezekiel A. Straw,	1865–78	Edw. W. Thomas,	1894–95
Amos D. Lockwood,	1878–80	A. M. Goodale,	1895–96
John Kilburn,	1880–83	Arthur H. Lowe,	1896–97
William C. Lovering,	1883–85	Russell W. Eaton,	1897–98
Richard Garsed,	1885–86	Stephen A. Knight,	1898–99
J. S. Ludlam,	1886–88	Frederick E. Clarke,	1899–99
Henry F. Lippitt,	1888–89	D. M. Thompson,	1900–01
Walter E. Parker,	1889–92	Charles H. Fish,	1901–03
Robert McArthur,	1892–94	H. E. WALMSLEY,	1903–

VICE-PRESIDENTS.

Amos D. Lockwood,	1865–77	Simeon B. Chase,	1891–93
William A. Burke,	1865–73	E. W. Thomas,	1892–94
John C. Palfrey,	1873–76	A. M. Goodale,	1893–95
Edward Atkinson,	1876–78	William J. Kent,	1894–97
A. G. Cumnock,	1877–80	Fred. C. McDuffie,	1895–00
Charles Nourse,	1878–81	Henry T. Whitin,	1897–00
William F. Goulding,	1880–83	C. H. Richardson,	1900–01
Richard Garsed,	1881–85	George H. Hills,	1900–02
J. S. Ludlam,	1883–86	H. E. Walmsley,	1901–03
Walter E. Parker,	1885–89	Alfred E. Adams,	1902–03
Richard B. Borden,	1886–88	JAMES R. MacCALL,	1903–
Arnold B. Sanford,	1888–91	W. D. HARTSHORNE,	1903–
Robert McArthur,	1889–92		

DIRECTORS.

J. S. Davis,	1865–69	S. S. Spencer,	1887–90
Charles Nourse,	1865–78	E. W. Thomas,	1888–92
Phineas Adams,	1865–74	William W. Whitin,	1888–93
William P. Haines,	1865–69	Robert R. Smith,	1889–92
Thomas J. Borden,	1865–78	Alfred M. Goodale,	1890–93
Daniel D. Crombie,	1865–68	William J. Kent,	1891–94
A. M. Wade,	1868–69	Herman F. Straw,	1891–93
D. J. Johnston,	1869–70	Fred C. McDuffie,	1892–95
F. E. Clarke,	1869–75	George W. Bean,	1892–95
A. G. Cumnock,	1869–77	F. M. Messenger,	1893–95
Cyrus I. Barker,	1875–80	Albert F. Knight,	1893–99
Hervey Kent,	1877–81	Arthur H. Lowe,	1894–96
David J. Johnston,	1878–82	Henry T. Whitin,	1894–97
Walter Paine, 3d,	1878–80	Herbert L. Pratt,	1895–98
Chas. L. Lovering,	1878–83	Stephen A. Knight,	1895–98
Richard Garsed,	1880–81	John Eccles,	1895–99
William H. Jennings,	1880–83	Russell W. Eaton,	1896–97
Chas. D. McDuffie,	1881–83	C. H. Richardson,	1897–00
Walter E. Parker,	1881–85	George H. Hills,	1897–00
John W. Danielson,	1881–85	John T. Meats,	1898–01
William E. Barrows,	1882–83	Alfred E. Adams,	1899–02
Rufus A. Maxfield,	1883–86	A. Tenny White,	1899–02
George W. Weeks,	1883–86	Charles H. Fish,	1900–01
Henry S. Howe,	1883–87	Herbert E. Walmsley,	1900–01
Richard B. Borden,	1883–86	Wm. D. Hartshorne,	1901–03
O. S. Brown,	1885–91	James R. MacColl,	1901–03
Henry F. Lippitt,	1885–88	GEO. F. WHITTEN,	1898–
Wilbur A. Stiles,	1886–88	W. B. SMITH WHALEY,	1901–
Robert McArthur,	1886–89	J. R. MONTGOMERY,	1902–
Stephen N. Bourne,	1886–91	WM. D. PENNELL,	1902–
John Kilburn,	1870–80	G. P. GRANT, Jr.,	1903–
William P. Haines,	1874–78	P. A. MATHEWSON,	1903–

AUDITORS.

Benjamin Saunders,	1865–71	J. Herbert Sawyer,	1882–00
John C. Palfrey,	1871–73	C. E. ROBERTS,	1900–
Henry D. Sullivan,	1873–82		

SECRETARY AND TREASURER.

Ambrose Eastman,	1865–94	C. J. H. WOODBURY,	1894

MEMBERS OF THE ASSOCIATION.

May 1, 1903.

Members of the Association are respectfully requested to scrutinize the following list, and advise the Secretary, P. O. Box 3672, Boston, Mass., of change in address, or any error in regard to their names.

As a number of members rejoined the Association after severing their first membership, the date of their earliest election is given.

HONORARY MEMBERS.

GEORGE ARMS	Grand Hotel	New York City	Oct. 16, 1872.
HENRY SMITH PRITCHETT, LL.D.,	Pres. Mass. Institute of Technology,	Boston, Mass.	Sept. 26, 1901.
SAMUEL WEBBER	Hydraulic Engineer	Charlestown, N. H.	Apr. 20, 1865.

ACTIVE MEMBERS.

Alfred E. Adams	Agt. Whitinsville Cotton Mills / Agt. Linwood Mills	Whitinsville, Mass.	Apr. 27, 1887.
John S. Adams, Jr.	Supt. Adams Bros. Mfg. Co. 120 Commercial St.,	Adams, Mass.	Apr. 29, 1896.
Joseph D. Aiken	Asst. Supt. Ponemah Mills	Taftville, Conn.	Oct. 28, 1891.
F. S. Akin	Supt. Cornell Mills	Fall River, Mass.	Sept. 27, 1894.
Charles T. Aldrich	Treas. Aldrich Mfg. Co. Box 34,	Providence, R. I.	Apr. 28, 1886.
George E. Ames	Mech. Supt. Lawrence Mfg. Co.	Lowell, Mass.	Apr. 24, 1895.
William Ames	Treas. Fletcher Manufg. Co., Box 83, 47 Charles St.,	Providence, R. I.	Apr. 30, 1879.
Charles B. Amory	Treas. Hamilton Manufg. Co. 70 Kilby St.,	Boston, Mass.	Apr. 25, 1894.
Frederic Amory	Treas. Nashua Mfg. Co. and Jackson Mfg. Co. Room 51, Simmons B'l'd., 40 Water St.,	Boston, Mass.	Apr. 27, 1899.
Thomas Armstrong	Supt. No. Pownal Mfg. Co.	No. Pownal, Vt.	Oct. 28, 1897
Abel T. Atherton	Machine Maker	Bay Side, R. I.	Oct. 16, 1872.
William F. Arthur	Supt. Nashua Mfg. Co.	Nashua, N. H.	Apr. 23, 1903.

Edward Atkinson . . . Prest. Boston Mfrs. Mu. Fire Ins. Co. . . . . 31 Milk St., Boston, Mass. . . . Apr. 19, 1871.
E. W. Atkinson . . . . Stoddard, Haserick, Richards & Co. . . . . 152 Congress St., Boston, Mass. . . . Oct. 27, 1886.
H. C. Atwood . . . . Treas. Williamsville Manufg. Co. . . Killingly, Conn. . . Apr. 29, 1885.
James A. Atwood . . . Agt. Wauregan Co. and Quinebaug Co. . . . . Wauregan, Conn. . . Oct. 28, 1891.
John Walter Atwood . Supt. Wauregan Co. . . . . Wauregan, Conn. . . Oct. 25, 1895.
W. E. Atwood . . . . Secy. and Asst. Treas. Williamsville Manufg. Co. . . . . Killingly, Conn. . . . Sept. 27, 1894.
George A. Ayer . . . Supt. West Boylston Co. . . . . Easthampton, Mass. . Apr. 24, 1895.
Nathaniel F. Ayer . . Agt. Farwell Mills . . . . . Lisbon, Me. . . . . Apr. 25, 1901.

G. H. T. Babbitt . . . Asst. Supt. Chicopee Mfg. Co. . . . . 340 Grove St., Chicopee, Falls, Mass. Oct. 2, 1902.
J. W. Bailey . . . . . Dir. The A. French Textile School . Atlanta, Ga. . . . . Apr. 23, 1903.
Dickerson G. Baker . . Mech. Eng., American Thread Co. . . . . P. O. Box B, Willimantic, Conn. . Oct. 18, 1900.
Edwin H. Baker . . . Bliss, Fabyan & Co., Box 2899 . . . . . 117 Duane St., New York City, N. Y. Apr. 24, 1878.
Edward R. Ballou . . . Treas. Ballou Yarn Co., ... 189 Charles St., Providence, R. I. . . . Apr. 25, 1894.
Frederick D. Ballou . . Supt. W. A. Slater Mills . . . . . Jewett City, Conn. . Apr. 23, 1903.
William P. Bancroft . . Vice-Pres. Joseph Bancroft & Sons Co. . . . . Wilmington, Del. . . Oct. 31, 1883.
Louis B. Barker . . . Agt. United States Cotton Co. . . . Central Falls, R. I. . Apr. 27, 1899.
V. T. Barber . . . . . Supt. Slater Cotton Co. . . . . Pawtucket, R. I. . . Oct. 2, 1902.
Lewis E. Barnes . . . Agt. Pemberton Co. & Methuen Co., Methuen, Mass. . . . Oct. 25, 1895.
William A. Barrell . . Agt. Lawrence Duck Co. . . . . Lawrence, Mass. . . Apr. 30, 1884.
Thomas Barrett, Jr. . . Pres. Langley & Aiken Mills . . . Augusta, Ga. . . . . Apr. 26, 1900.
Edwin N. Bartlett . . . Supt. Sigourney and Rockdale Mills, North Oxford, Mass. . Apr. 29, 1891.
Daniel Moore Bates . Asst. Supt. Joseph Bancroft & Sons Co., ... Rockford, Wilmington, Del. . . Apr. 27, 1898.
Joseph P. Battles . . . Crompton & Knowles Loom Works, Worcester, Mass. . . Oct. 25, 1895.
Edward C. Beach . . Supt. Gate City Cotton Mills . . . East Point, Georgia . Oct. 5, 1899.
C. Enos Bean . . . . Supt. Millville Mfg. Co. . . . . Millville, N. J. . . . Apr. 24, 1902.
George W. Bean . . . Agt. Androscoggin Mills . . . . . Lewiston, Me. . . . Apr. 17, 1872.
Robert Beatty . . . . Robert Beatty & Co. . . . . Coral and Adams Sts., Philadelphia, Pa. . . Oct. 28, 1897.
Truman Beckwith . . . Treas. Dyerville Manufg. Co. . . . . 610 Manton Ave., Providence, R. I. . . Apr. 27, 1892.
John W. Bell . . . . . Asst. Treas. and Gen. Mgr. Smith & Dove Manufg. Co. . . . . Andover Mass. . . . Oct. 28, 1897.
Albert Farwell Bemis . Pres. Jackson Fibre Co., (Jackson, Tenn.) . . . . . P. O. Box 5173, Boston, Mass. . . . Apr. 23. 1903.

A. C. Bent	Agt. Safety Seamless Pocket Co.	Taunton, Mass.	Oct. 28, 1897.
William H. Bilbrough	Mgr. Elmira Knitting Mills and Mgr. Conewawah Spinning Co.	Elmira, N. Y.	Apr. 24, 1902.
W. N. Blackstone	Treas. Attawaugan Co. Treas Totokett Mills Co	Norwich, Conn.	Apr. 29, 1896.
Wm. Washington Blades, Gen. Supt.	Lorraine Mfg. Co.	135 Mineral Spring Ave., Pawtucket, R. I.	Oct. 25, 1893.
T. Ashby Blythe	Proprietor Ashby Cotton Mills	114 Chestnut St., Philadelphia, Pa.	Oct. 28, 1897.
John P. Bodge	Treas. Arkwright Mills	Fall River, Mass.	Oct. 28, 1897.
Jefferson Borden, Jr.	Supt. Fall River Bleachery Co.	Fall River, Mass.	Apr. 21, 1869.
Nathaniel B. Borden	Treas. Barnard Manufg. Co.	Fall River, Mass.	Oct. 15, 1873.
Richard B. Borden	Treas. Richard Borden Mfg. Co. Treas. Troy C. & W. Mfg. Co.	Fall River, Mass.	July 19, 1865.
E. S. Boss	Agt. American Thread Co.	Willimantic, Conn.	Oct. 29, 1879.
A. E. Bosworth	Supt. Bernon Mills	Georgiaville, R. I.	Oct. 2, 1902.
Henry Deane Bourne	Treas. Hooksett Mfg. Co., 1741 Elm St.	Manchester, N. H.	Oct. 18, 1900.
Stephen N. Bourne	Agt. Dundee Mills	Hooksett, N. H.	Oct. 21, 1868.
Frank A. Bowen	Supt. Appleton Co.	Lowell, Mass.	Apr. 28, 1897.
Arthur F. Brackett	Supt. Royal Arctic & Valley Queen Mills,	Riverpoint, R. I.	Oct. 25, 1895.
Albert W. Brainerd		Box 33, Lawrence, Mass.	Apr. 27, 1898.
S. Parker Bremer	Treas. Monadnock Mills	4 Winthrop Sq., Boston, Mass.,	Oct. 2, 1902.
Ernest Bridge	Supt. Jas. Chadwick & Bro. Ltd.	Jersey City, N. J.	Apr. 24, 1895.
George T. Briggs,	Pres. and Gen. Mgr. The Briggs Mfg. Co.	Voluntown, Conn.,	Apr. 24, 1902.
Christopher P. Brooks	Managing Director New Bedford Textile School	New Bedford, Mass.	Apr. 28, 1897.
Henry R. Brown	Supt. Phenix Mill	Box 56, Phenix, R. I.	Apr. 28, 1897.
Isaac A. Brown	Treas. Narragansett Mills	Box 324, Fall River, Mass.	Sept. 29, 1898.
James W. Brown		P. O. Box 312, Ipswich, Mass.	Oct. 15, 1873.
O. S. Brown	Agt. Salmon Falls Manufg. Co.	Salmon Falls, N. H.	Apr. 21, 1875.
Thomas J. Brown	George Brown's Sons	Mt. Joy, Penn.	Oct. 28, 1897.
E. C. Bucklin	Treas. Interlaken Mills	Butler's Exchange, Box 289, Providence, R. I.	Apr. 25, 1883.
Harris H. Bucklin	Asst. Treas. Interlaken Mills	Providence, R. I.	Apr. 23, 1903.
Robert Burgess	Treas. Slater Cotton Co.	128 Walcott St., Pawtucket, R. I.	Apr. 27, 1892.
Edward N. Burke	Lowell Machine Shop	Lowell, Mass.	Apr. 28, 1880.
Alfred H. Burnham	Mgr. Glasgow Mills, Station Kensington	Huntington and Jasper Sts., Philadelphia, Pa.	Apr. 26, 1900.
Hervey Burnham	Supt. Beaver Mills and Eclipse Mill	234 East Main St., North Adams, Mass.	Apr. 27, 1899.
W. R. Burnham		Norwich, Conn.	Apr. 29, 1885.
John L. Burton	Agt. Newmarket Mfg. Co.	Newmarket, N. H.	Apr. 23, 1903.

William H. Cadwell . . Agt. Jackson Company . . . . . Nashua, N. H. . . . Apr. 26, 1900
John P. Campbell . . . Supt. New York Mills, New York Mills, Oneida Co., N. Y., Sept. 22, 1896.
Byron F. Card . . . . Mgr. . . . . 300 Chestnut St., Philadelphia, Pa. . . Apr. 25, 1888.
Samuel A. Carter . . . Pres. Gate City Cotton Mills . . . . Atlanta, Ga. . . . . Sept. 26, 1901.
George A. Chace . . . Treas. Bourne Mills . . . Box 115, Fall River, Mass. . . Apr. 25, 1877.
John W. Chafee . . . Pres. and Treas. The Sibley Mfg. Co. Augusta, Ga. . . . . Oct. 18, 1900.
Simeon B. Chase . . . Treas. King Philip Mills . . . . . Fall River, Mass. . . Apr. 21, 1875.
Clarence N. Childs . . Asst. Supt. Hamilton Manufg. Co. . . . . 43 Pine St., Lowell, Mass. . . . Apr. 24, 1895.
Elmer G. Childs . . . Agt. Boston Duck Co. . . . . Bondsville, Mass. . . Oct. 26, 1892.
Jno. H. C. Church . . . Asst. Treas and Sec. Monument Mills, Gt. Barrington, Mass. Apr. 28, 1897.
Daniel Clark . . . . . 16 Fifth Ave., Lowell, Mass. . . . Apr. 23, 1903.
Ernest E. Clark . . . Mech. Supt. Montreal Cotton Co. . . Valleyfield, P. Q. . . Apr. 29, 1896.
E. N. Clemence . . . Sec. and Treas. Eagle & Phenix Mills, Columbus, Ga. . . . Apr. 28, 1897.
W. H. Cloher, Jr. . . . Treas. and Agt. Utica Cotton Co. Capron, Oneida Co., N. Y., Sept. 22, 1896.
Josiah G. Coburn . . . . . 99 Washington St., Newton, Mass. . . . Apr. 20, 1865.
Charles H. Collins . . Supt. Berkeley Co. . . . . Ashton, R. I. . . . . Apr. 26, 1900.
John A. Collins . . . . Supt. American Linen Co. . . . . 73 Cottage St., Fall River, Mass. . . Oct. 31, 1883.
B. B. Comer . . . . . Pres. and Treas. Avondale Cotton Mills . . . . . Birmingham, Ala. . . Apr. 26, 1900.
Frank B. Comins . . . Treas. American Moistening Co. . . . . 150 Devonshire St., Room 67, Boston, Mass. . . . . Oct. 28, 1891.
Caesar Cone . . . . . Pres. Proximity Mfg. Co. . . . . Greensboro, N. C. . . Apr. 26, 1900.
John J. Connell . . . . Agt. Tremont & Suffolk Mills . . . Lowell, Mass. . . . Apr. 27, 1892.
Halsey Connett . . . . Supt. Clark Mile End Spool Cotton Co. East Newark, N. J. . Oct. 2, 1902.
Peter H. Corr . . . . Treas. Greenwich Bleachery . . . . Taunton, Mass. . . . Apr. 24, 1895.
Frank H. Cotton . . . Mgr. Hope Mills Mfg. Co. . . . Hope Mills, N. C. . . Apr. 27, 1899.
Lyman M. Cousens, . . Pres. Dana Warp Mills . . . . . Portland, Me. . . . Apr. 24, 1902.
Alphonse S. Covel . . Treas. Tremont and Suffolk Mills, ... P. O. Box 1716, 70 Kilby St., Boston, Mass. . . . Oct. 31, 1877.
Richard Cowell . . . . . 290 Summer St., New Bedford, Mass. . Apr. 24, 1902.
William W. Crapo . . Pres. Wams[illegible]a Mills . . . . . New Bedford, Mass. . Sept. 29, 1898.
William J. Cray . . . Supt. Ald[illegible] Mfg. Co. . . . . Moosup, Conn. . . . Apr. 25, 1901.
John B. Cudlip . . . . Mgr. Co[illegible] l & York Cotton Mills Co. . . . . St. John, N. B. . . . Apr. 28, 1897.
H. H. Culver . . . . . Supt. [illegible] Poole Mills . . . . . 39 Ashland St., Taunton, Mass. . . . Apr. 28, 1897.
Henry S. Culver . . . Sup[illegible] Cotton Mills . . . . Taunton, Mass. . . . Apr. 28, 1897.
A. G. Cumnock . . . . Tre[illegible] n Co. . . . Box 2284, Lowell, Mass. . . . July 19, 1865.
Andrew J. Currier . . Gen. [illegible] . Cotton Yarn Co. . Taunton, Mass. . . . Apr. 25, 1888.

Philip Dana . . . . . Supt. Dan[illegible] Warp Mills . . . . . Westbrook, Me. . . Sept. 29, 1898.
Woodbury K. Dana . . Treas. Da[illegible] Warp Mills . . . . . Westbrook, Me. . . . Apr. 25, 1888.

Albert W. Danforth	Mech. Eng. Shanghai Cot. Cloth Mills, Shanghai, China		
	881 Bridge St., Lowell, Mass.	Apr.	27, 1881.
A. Lockwood Danielson	Asst. Treas. Quinebaug Co., Box 900,	Providence, R. I.	Sept. 27, 1894.
J. DeForest Danielson	Asst. Treas. Lockwood Co. & Lewiston Bleachery & Dye Works	Providence, R. I.	Sept. 27, 1894.
John W. Danielson	Treas. Lockwood Co. and Ponemah Mills		
	Box 900,	Providence, R. I.	July 15, 1868.
E. W. Davenport	Supt. Brighton Mills	Passaic, N. J.	Apr. 23, 1903.
Bradford D. Davol	Pres. Barnard Mfg. Co.	P. O. Box 418, Fall River, Mass.	Apr. 25, 1877.
Albert Deabill	Supt. Lowell Hosiery Co., Mt. Vernon St.		
		Lowell, Mass.	Apr. 25, 1901.
Augustus De Cort	Treas. Beacon Mfg. Co.		
	P. O. Box 2815, 65 Franklin St., Boston, Mass.		Apr. 26, 1900.
George DeForest	Treas. Utica Steam & Mohawk Valley Cotton Mills		
		Utica, New York	Oct. 28, 1897.
William P. Dempsey	Treas. Dempsey Bleachery and Dye Works,	Pawtucket, R. I.	Apr. 28, 1886.
Charles W. Dennett	Vice Pres. and Agt. Johnson-Dunbar Mills Co.	North Adams, Mass.	Oct. 29, 1890.
Edward P. Dennis	Lowell Machine Shop	Lowell, Mass.	Apr. 25, 1888.
Charles A. Denny		Leicester, Mass.	Apr. 25, 1888.
P. Y. DeNormandie	Treas. Pepperell Mfg. Co.		
	30 Kilby St.,	Boston, Mass.	Apr. 29, 1896.
Charles Owen Dexter	Mgr. Canadian Colored Cotton Mills Co. Ltd.		
		Hamilton, Ont., Can.	Apr. 24, 1895.
Henry C. Dexter,	Agt. and Sec. Greene & Daniels Mfg. Co.		
		Pawtucket, R. I.	Apr. 25, 1901.
Lewis Dexter, Jr.	Mgr. The Canadian Colored Cotton Mills Co., Ltd.		
		Milltown, N. B.	Apr. 27, 1899.
F. Dilling	Pres. Dilling Cotton Mills	Kings Mountain, N. C.	Oct. 25, 1895.
Albert W. Dimick	Agt. Fisher Mfg. Co.	Fisherville, Mass.	Apr. 25, 1894.
Bradford C. Divine	Supt. Utica Willowvale Bleaching Co.	Chadwicks, N. Y.	Apr. 27, 1899.
Robert Dow,	Partner in Solway Mills,	Westerly, R. I.	April 25, 1901.
Arthur J. Draper	Treas. Pell City Mfg. Co.	Pell City, Ala.	Apr. 23, 1903.
Eben S. Draper	Agt. Draper Co.	Hopedale, Mass.	Oct. 31, 1888.
George A. Draper	Treas. Draper Co.	Hopedale, Mass.	Oct. 31, 1888.
George Otis Draper	Sec'y Draper Co.	Hopedale, Mass.	Apr. 24, 1895.
William F. Draper	Pres. Draper Co.	Hopedale, Mass.	July 17, 1867.
William F. Draper, Jr.	Draper Co.	Hopedale, Mass.	Oct. 29, 1890.
Harry K. Drew	Supt. Clinton Mfg. Co., 93 Clinton	Pawtucket, R. I.	Apr. 24, 1902.
O. D. Drew	Supt. Peabody Manufacturing	Newburyport, Mass	Oct. 2, 1902.
James B. Duggan	Pres. Union Bleaching and Finis		
		Greenville, S. C.	Oct. 2, 1902.
Frederic C. Dumaine,	Treas. Amory Mfg. Co., Box 2879		
		Boston, Mass.	April 25, 1901.
Joseph M. Dunham		Springfield, Mass.	Oct. 26, 1892.
Frank J. Dutcher	Asst. Agt. Draper	Hopedale, Mass.	Apr. 24, 1902.
Frank H. Dwelly	Treas. Tecumseh M	Fall River, Mass.	Apr. 27, 1899.

David H. Dyer . . . . D. H. Dyer & Son, Mill Engineers, P. O. Box 582, . . .
. . . . . 6, 7 and 8 Pocassett Bank Building, Fall River, Mass. . . Oct. 18, 1871.

Benjamin M. Earle . . Prop. Merchants Dye Works . . . . East Dedham, Mass. Sept. 26, 1901.
Wm. Ambrose Eastman, Gen. Mgr. Hooper Knitting Co. . . Lowell, Mass. . . . Apr. 24, 1878.
Russell W. Eaton . . . Agt. Cabot Manufg. Co. . . . . Brunswick, Me. . . . Oct. 27, 1887.
John Eccles . . . . . Agt. Ponemah Mills . . . . . Taftville, Conn. . . . Apr. 27, 1892.
Oscar Elsas . . . . . Vice-Pres. Fulton Bag & Cotton Mills, ...
. . . . . P. O. Box 773, Atlanta, Ga. . . . . Apr. 28, 1897.
Frederick W. Ely . . . Agt. Columbian Manufg. Co. . . . Greenville, N. H. . . Apr. 25, 1888.
H. B. Estes . . . . . Agt. Continental Mills . . . . . Lewiston, Me. . . . Apr. 26, 1893.
John H. Estes . . . . Cotton Manufacturer . . . . . Fall River, Mass. . . Apr. 23, 1903.
William Evans . . . . Treas. Wampanoag Mills . . . . . Fall River, Mass. . Apr. 29, 1896.
D. A. Everly . . . . . Cotton Mfr. . . . . 96 Broad St., Pawtucket, R. I. . . Apr. 24, 1902.

Charles F. Farrar . . . . . 22 Coggeshall St., Fall River, Mass. . . Oct. 28, 1897.
George E. Farrell . . . Treas. Utica Spinning Co. . . . . Utica, N. Y. . . . . Oct. 18, 1900.
James T. Ferguson . . Supt. Warwick Mills . . . . . Centreville, R. I. . . Oct. 5, 1899.
Frank S. Field . . . . Supt. & Agt. Massaemit Yarn Mills . Shattuckville, Mass. . Oct. 25, 1895.
William Firth . . . . Pres. American Moistening Co. & Wm. Firth Co. . . . .
. . . . . P. O. Box 1460, 150 Devonshire St., Room 67, Boston, Mass. Apr. 25, 1888.
Charles H. Fish . . . . Agt. Cocheco Manufg. Co. . . . Dover, N. H. . . . . Apr. 27, 1887.
Charles W. Fisher, . . Asst. Supt. Fisher Mfg. Co. . . . . Fisherville, Mass. . . Apr. 25, 1901.
Henry E. Fisher . . . Vice-Pres. & Agt. Atlanta Cotton Mills Atlanta, Ga. . . . . Oct. 25, 1895.
Herbert Fisher . . . . . Taunton, Mass. . . . Oct. 29, 1879.
William B. Fitz . . . . . Easthampton, Mass. . Oct. 26, 1892.
Frederick A. Flather . Gen. Supt. International Harvester Co. (McCormick Div) .
. . . . . Blue Island and Oakley Aves., Chicago, Ill. . . . . Apr. 29, 1891.
F. C. Fletcher . . . . Vice Pres. Lawton Spinning Co. . . . . .
. . . . . 621 Banigan Building, Providence, R. I. . . Oct. 18, 1900.
M. F. Foster . . . . . Milford, N. H. . . . Apr. 17, 1872.
Philip H. Fowler . . 417 Monmouth St., ... Gloucester City, N. J. Nov. 30, 1881.
Edward W. France . . Dir. of Philadelphia Textile School, ...
. . . . . 320 So. Broad St., Philadelphia, Pa. . . Sept. 22, 1896.
Arthur C. Freeman . . . . . 17 Exchange Place, Providence, R. I. . . Apr. 27, 1899.
Simon Friedberger . . Pres. Friedberger Mfg. Co. . . . . .
. . . . . Germantown, Logan Station, Philadelphia, Pa. . . Apr. 23, 1903.
John W. Fries . . . . Managing Partner, F. & H. Fries, . Winston-Salem, N. C. Oct. 18, 1900.
C. H. Frisbie . . . . . Agt. Attawaugan Co. . . . . Norwich, Conn. . . . Oct. 29, 1890.

W. T. Galey . . . . . Pres. Aberfoyle Manufg. Co. . . . Chester, Pa. . . . . Apr. 28, 1897.
William Gammell . . . Agt. Berkeley Co. . . . . Providence, R. I. . . Oct. 28, 1885.
James G. Garland . . . . . Saco, Me. . . . . Oct. 29, 1879.
Edward T. Garsed . . Supt. Pell City Mfg. Co. . . . . Pell City, Ala. . . . Apr. 27, 1898.
James A. Gary . . . . Pres. Gary Mfg. Co. 108 German St., Baltimore, Md. . . . Apr. 25, 1883.
James Gee . . . . . Supt. Interlaken Dye Works . . . . Fiskville, R. I. . . . Apr. 27, 1898.

Charles E. Getchell . . Pres. Waltham Emery Wheel Co. . . . . Bacon St., Waltham, Mass. . . . Oct. 30, 1889.
William C. Godfrey . . Agt. Indian Orchard Co. . . . . Indian Orchard, Mass. Oct. 29, 1890.
Otto Goetze, ... Partner and Gen. Mgr. Glasgow Mills . . . . . Huntington and Jasper Sts., Philadelphia, Pa. . . Apr. 24, 1902.
Alfred M. Goodale . . Treas. Boston Manufg. Co. . . . . 50 State St., Boston, Mass. . . . . Apr. 25, 1883.
Louis B. Goodall . . . Treas. Goodall Worsted Co. . . . . Sanford, Me. . . . . Oct. 5, 1899.
Frederick B. Gordon . Pres. Columbus Mfg Co. . . . . Columbus, Ga. . . . Apr. 26, 1900.
Charles H. Gorton . . Supt. Columbus Mfg. Co. . . . . Columbus, Ga. . . . Apr. 25, 1894.
Marcellus Gould . . . Pres. and Mgr. N. H. Spinning Mills, Penacook, N. H. . . Sept. 22, 1896.
George P. Grant, Jr. . Treas. Grant Yarn Co. . . . . Fitchburg, Mass. . . Sept. 27, 1894.
D. W. Gray . . . . . Supt. Skenandoa Cotton Co. . . . . Utica, N. Y. . . . . Oct. 26, 1892.
R. A. Gray . . . . . Supt. Rodman Manufg. Co. . . . . Allenton, R. I. . . . Apr. 24, 1895.
Joseph Warren Greene. . Supt. . . . . Wickford, R. I. . . . Apr. 29, 1896.
William C. Greene . . Treas. Peace Dale Manufg. Co. . . Peace Dale, R. I. . . Oct. 27, 1886.
John T. Greenwood . . R. Greenwood & Bault . . . . . 4720 Leiper St., Frankford, Philadelphia, Pa. . . Apr. 26, 1900.
S. Greenwood . . . . Mgr. Canadian Col'd Cot. Mills Co. Ltd. . . . . Cornwall, Ontario . . Oct. 5, 1899.
John Gregson . . . . Agt. Fiskdale Mills . . . . . Fiskdale, Mass. . . . Apr 24, 1895.
Maxwell Grierson . . . Gen. Mgr. Jas. Chadwick & Bro., Ltd., Jersey City, N. J. . . Apr. 27, 1898.
Frederick Grinnell . . Pres. Gen. Fire Extinguisher Co. . . New Bedford, Mass. . Apr. 24, 1878.
David Grove . . . . . Supt. U. S. Cotton Co. . . . . Central Falls, R. I. . Apr. 27, 1898.
Henry S. Grove . . . Pres. Argo Mills Co., ... 318 Marine and Merchant Bldg., Philadelphia, Pa. . . Apr. 27, 1898.
Louis I. Guion . . . . Supt. Columbia Mills Co., ... Columbia, S. C. . . . Oct. 2, 1902.
Arthur H. Gulliver . . Agt. Boston Mfg. Co. . . . . Waltham, Mass. . . Apr. 24, 1889.

William J. Hadfield . . Newburgh Steam Mills, ... 236 Montgomery St., Newburgh, N. Y. . . . Apr. 27, 1899.
Frank J. Hale . . . . Gen. Agt. Saco and Pettee Machine Shops . . . . . Newton Upper Falls, Mass. . Apr. 27, 1892.
Walter B. Hall . . . . Supt. Pontiac Mill, B. B. & R. Knight, Pontiac, R. I. . . . . Apr. 25, 1901.
William E. Hall . . . Treas. Shaw Stocking Co. . . . . Lowell, Mass. . . . Apr. 27, 1892.
Z. D. Hall . . . . . Supt. Berkshire Cotton Mfg. Co. . . . . 70 Orchard St., P. O. Box 963, Adams, Mass. . . . Oct. 29, 1879.
William Halliwell, . . Agt. Providence and Woonsocket Mills of the Lawton Spinning Co., Woonsocket, R. I. . Sept. 26, 1901.
John H. Hambly . . . Treas. Quidnick Manufg. Co. . . . . 49 Westminster St, Providence, R. I. . . . Apr. 24, 1895.
Arthur M. Hamilton . . Supt. Hargraves and Parker Mills . . . . . 267 Hanover St., Fall River, Mass. . . Apr. 28, 1897.
John F. Hamlet . . . Manufacturer . . . P. O. Box 160, Fall River, Mass. . . Oct. 31, 1888.
Joseph O. Hannum . . . . . 1805 10th Ave. South, Birmingham, Ala. . . Apr. 30, 1890.
Peter Hardman . . . Supt. American Thread Co., Willimantic Mills . . . . . Willimantic, Conn. . Apr. 23, 1903.

A. G. Harris, ... 10 Third St., Upper Troy, N. Y. . Sept. 26, 1901.
Henry F. Harris . . . Treas. West Boylston Manufg. Co. . . . . .
. . . . . 340 Main St., Worcester, Mass. . . Apr. 30, 1890.
W. G. Hartford . . . . Agt. Hamlet Textile Co. . . . . Woonsocket, R. I. . . Apr. 23, 1903.
William D. Hartshorne Agt. Arlington Mills . . . . . Lawrence, Mass. . . Apr. 27, 1899.
Walter M. Hastings . . Asst. Agt. Arlington Mills . . . . . Lawrence, Mass. . . Apr. 23, 1903.
Samuel E. Hathaway . Supt. Fall River Iron Works Co. . . Fall River, Mass. . . Sept. 27, 1894.
William Hathaway . . Supt. Barnard Manufg. Co. . . . . Fall River, Mass. . . Apr. 25, 1894.
William B. Hawes . . Yarn Broker . . . 108 Bedford St., ...
. . . . . P. O. Box 733, Fall River, Mass. . . Apr. 24, 1895.
Alfred Hawkesworth . Supt. Merchants' Cotton Co. . . . . Montreal, P. Q. . . . Apr. 26, 1893.
Fred Hawkesworth . . Asst. Supt. Merchants' Cotton Co. . Montreal, P. Q. . . . Sept. 22, 1896.
William Hayes . . . . Agt. Barker Mill . . . . . Auburn, Me. . . . . Apr. 30, 1879.
W. G. Henderson . . . Agt. Falls Co. . . . . Norwich, Conn. . . . Apr. 29, 1896.
A. E. Henry, ... Mfr. Partner in Solway Mills, . . . Westerly, R. I. . . . Apr. 25, 1901.
Ernest L. Hersom . . Supt. Nockege Mill . . . . . Fitchburg, Mass. . . Apr. 23, 1903.
T. I. Hickman, ... Pres. and Treas. Graniteville Mfg. Co. . . . . .
. . . . . Leonard Bldg., Augusta, Ga. . . . . Apr. 25, 1901.
Ernest L. Hill . . . . Vice-Pres. Renfrew Mfg. Co. . . . . .
. . . . . 320 Broadway, New York City . . . Apr. 24, 1902.
William H. Hill . . . Pres. Windsor Co. and Pres. Renfrew Mfg. Co. . . . . .
. . . . . 40 Water St., Boston, Mass. . . . Apr. 24, 1902.
George H. Hills . . . Treas. Davol Mills & Stevens Mfg. Co., Fall River, Mass. . . Oct. 25, 1895.
Charles H. Hobbs . . Agt. Thorndike Co. . . . . Thorndike, Mass. . . Apr. 28, 1886
Franklin W. Hobbs . . Treas. Arlington Mills . . . . . .
. . . . . P. O. Box 5317, 78 Chauncy St., Boston, Mass. . . . Apr. 27, 1899.
William Henry Hobbs . Asst. Supt. Johnson & Johnson Co., New Brunswick, N. J. Apr. 24, 1902.
Louis L. Hohn . . . . Cor. Connecticut Ave. and McDonald St., New London, Conn. Apr. 28, 1897.
Charles M. Holmes . . Supt. Natick Mills . . . . . Natick, R. I., . . . Apr. 27, 1899.
Gideon F. Holmes . . Treas. and Gen. Mgr. Plymouth Cor- . . . . . .
. . . . . dage Co. . . . . No. Plymouth, Mass. . Oct. 30, 1889.
George W. Holt . . . Agt. Monohansett Manufg. Co. . . Putnam, Conn. . . . Oct. 29, 1879.
John H. Holt . . . . Supt. Totokett Mills Co. . . . . Versailles, Conn. . . Apr. 23, 1903.
Walter L. Holt . . . . Pres. Holt-Morgan Mills . . . . . Fayetteville, N. C. . . Oct. 18, 1900.
William P. Holt . . . Supt. Barnaby Mills . . . . . Fall River, Mass. . . Oct. 25, 1893.
Wm. E. Hooper . . . Mgr. Woodberry Div. of Mt. Vernon Woodberry Co. . . . .
. . . . . Woodberry, Baltimore, Md. . . . Apr. 23, 1903.
Edward W. Houghton . Supt. Globe Mill . . Manville Co., Woonsocket, R. I. . . Apr. 24, 1902.
Henry S. Houghton, Jr. Supt. Paul Whitin Manufg. Co. . . Northbridge, Mass. . Apr. 24, 1895.
W. C. Houston . . . . Pres. Hope Mills Manufg. Co. . . . . .
. . . . . 333 Drexel Building, Philadelphia, Pa. . . Apr. 28, 1897.
Elisha H. Howard . . Cotton Goods Broker, 20 Market Sq., Providence, R. I. . . Apr. 25, 1883.
Henry S. Howe . . . . Dry Goods Commission . . . . . .
. . . . . 89 Franklin St., Boston, Mass. . . . Oct. 31, 1877.
Albert C. Hoy . . . . . Woonsocket, R. I. . . Apr. 27, 1898.
Charles W. Hubbard . Treas. and Sec. Ludlow Mfg. Associates . . . . . .
. . . . . 133 Essex St., Boston, Mass. . . . Apr. 25, 1901.

Otis L. Humphrey, . . Cotton Dept. Lowell Textile School, Lowell, Mass. . . . Apr. 25, 1901.
Arthur W. Hunking . . . . . 374 Stevens St., Lowell, Mass. . . . Apr. 24, 1895.
George A. Hurd, ... 76 Broadway, Dover, N. H. . . . . Apr. 25, 1901.

D. Edwin Irving . . . Treas. The Irving & Leiper Mfg. Co., Chester, Pa. . . . . Oct. 28, 1897.

Joseph B. Jamieson . . Mgr. Boston Office of New England Cotton Yarn Co. . .
. . . . . 77 Summer St., Boston, Mass. . . . Oct. 2, 1902.
J. E. Jenckes . . . . . Treas. E. Jenckes Manufg. Co. & E. Jenckes Spinning Co.
. . . . . Pawtucket, R. I. . . Apr. 24, 1895.
Edward B. Jennings . . Treas. Samoset Co. . . . . Valley Falls, R. I. . . Sept. 29, 1898.
John L. Jerome . . . . Treas. Overland Cotton Mill Co. . . Denver, Col. . . . . Apr. 23, 1903.
David L. Jewell . . . Agt. China, Webster & Pembroke Mills . Suncook, N. H. . Apr. 20, 1865.
David S. Johnston . . Gen. Supt. Harmony Mills . . . . Cohoes, N. Y. . . . Oct. 28, 1891.
Gordon A. Johnstone . Agt. Danielson Cotton Co. . . . . Danielson, Conn. . . Apr. 23, 1903.
W. T. Jordan . . . . Mgr. Mountain Island Mfg. Co. . . Mountain Island, N. C. Oct. 25, 1895.

W. E. Keach . . . . . Supt. Grant Yarn Co. . 123 Myrtle Ave., Fitchburg, Mass. Oct. 26, 1892.
Roland R. Kelly . . . Supt. Williamstown Manufg. Co. . Williamstown Sta., Mass. Nov. 30, 1881.
George E. Kent . . . . Treas. Exeter Manufg. Co. . . . . Exeter, N. H. . . . Oct. 31, 1888.
Hervey Kent . . . . . Pres. Exeter Manufg. Co. . . . . Exeter, N. H. . . . Apr. 20, 1865.
Nathaniel B. Kerr . . . Treas. Butler Mill . . . . . New Bedford, Mass. . Oct. 26, 1892.
John Kilburn . . . . . Belmont, Mass. . . . Apr. 20, 1865.
Harry W. Kimball . . Supt. Fulton Bag & Cotton Mills . Atlanta, Ga. . . . . Oct. 25, 1895.
William N. Kimball . . Supt. Social and Nourse Mills, Manville Co. . . . . .
. . . . . Woonsocket, R. I. . . Apr. 24, 1902.
Emil Kipper . . . . . Treas. Renfrew Mfg. Co. and Windsor Print Works . . .
. . . . . Adams, Mass. . . . . Apr. 24, 1902.
Albert F. Knight . . . Mfr. Fine White Cotton Goods and Yarns . . . . . .
. . . . . Box 835, Providence, R. I. . . Oct. 27, 1886.
Jesse A. Knight . . . . Supt. Cohannet Mills . . . . . Taunton, Mass. . . . Oct. 26, 1892.
Stephen A. Knight . . Pres. Hebron Manufg. Co., Box 820, Providence, R. I. . . Oct. 21, 1868.
Walter B. Knight . . . Reynolds Manufg. Co. . . . . Davisville, R. I. . . Apr. 24, 1889.
Webster Knight . . . B. B. & R. Knight's Mills . . . . . .
. . . . . 3 Washington Row, Providence, R. I. . . Oct. 31, 1888.

Fred Lacey . . . . . Mgr. Montreal Cotton Co. . . . . Valleyfield, P. Q. . . Apr. 24, 1895.
Elliott Cowdin Lambert Supt. Amoskeag Manufg. Co. . . . Manchester, N. H. . Oct. 25, 1895.
William T. Lang . . . Agt. Brookside Mills . . . . . Knoxville, Tenn. . . Apr. 28, 1897.
Walter H. Langshaw . Agt. Dartmouth Manufg. Corp. . . New Bedford, Mass. . Apr. 29, 1896.
George H. Law . . . Supt. Merchants' Mfg. Co. . . . . .
. . . . . 815 Walnut St., Fall River, Mass. . . Apr. 28, 1897.
Harold Lawton . . . . Mgr. Baltic Mills Co. . . . . Baltic, Conn. . . . Oct. 27, 1886.
John Edward Lawton . Governing Director American Thread Co., ...
. . . . . Matlock, Derbyshire, England . Apr. 25, 1901.

Calvin H. Lee	Supt. Readville Cotton Mills	Hyde Park, Mass.	Apr. 24, 1902.
Evan Arthur Leigh	Textile Machinery	70 Kilby St., Boston, Mass.	Oct. 29, 1890.
John Leiper	Supt. Fitchburg Worsted Mills, Upland Road	Fitchburg, Mass.	Oct. 28, 1897.
J. Colby Lewis	23 Ralph St., Olneyville,	Providence, R. I.	Oct. 26, 1892.
Charles F. Libby	Supt. Shaw Stocking Co.	Lowell, Mass.	Apr. 24, 1902.
Leontine Lincoln	Pres. Seaconnet Mills	Fall River, Mass.	Apr. 28, 1897.
B. F. G. Linnell	Commission Merchant, Yarns, Threads and Twines	37 Summit St., P. O. Box 645, Central Falls, R. I.	Oct. 28, 1897.
Charles Warren Lippitt,	Treas. Silver Spring B. & D. Co.	7 Young Orchard Ave., Providence, R. I.	Oct. 30, 1878.
Henry F. Lippitt	Gen. Mgr. Social and Manville Cos.,	Providence, R. I.	Apr. 27, 1881.
William H. Loftus	Supt. Clark Thread Co.	Newark, N. J.	Oct. 28, 1897.
Robert W. Lord	Agt. R. W. Lord & Co.	Kennebunk, Me.	Oct. 20, 1869.
Ernest Lovering	Agt. Lyman Mills	Holyoke, Mass.	Apr. 25, 1888.
Henry M. Lovering	Agt. Whittenton Manufg. Co.	Taunton, Mass.	Oct. 27, 1880.
William C. Lovering	Pres. Whittenton Manufg. Co.	50 State St., Boston, Mass.	Oct. 25, 1876.
William M. Lovering	Supt. Whittenton Manufg. Co.	Taunton, Mass.	Sept. 27, 1894.
Arthur H. Lowe	Treas. Parkhill Manufg. Co.	Fitchburg, Mass.	Oct. 30, 1889.
David Lowe	Supt. Parkhill Manufg. Co.	Fitchburg, Mass.	Apr. 24, 1895.
A. Lawrence Lowell	Trustee	843 Exchange Building, 53 State St., Boston, Mass.	Apr. 25, 1901.
Dudley T. Lyall	Sec. Brighton Mills	Passaic, N. J.	Sept. 22, 1896.
William L. Lyall	Treas. Brighton Mills	Passaic, N. J.	Oct. 26, 1892.
Herbert Lyman		39 Beacon St., Boston, Mass.	Oct. 25, 1895.
Otis G. Lynch	Supt. Enterprise Manufg. Co.	Augusta, Ga.	Oct. 25, 1895.
Alvin S. Lyon	Supt. Bigelow Co.	Lowell, Mass.	Apr. 26, 1882.
James R. MacColl	Treas. Lorraine Manufg. Co.	Pawtucket, R. I.	Apr. 24, 1895.
Charles L. Macomber	Pres. Winthrop Cotton Yarn Co.	Taunton, Mass.	Apr. 24, 1895.
Frederick B. Macy,	Treas. Soule Mills,	New Bedford, Mass.	Apr. 25, 1901.
Amos G. Maddox	Supt. Linwood Mill	Linwood, Mass.	Oct. 18, 1900.
Charles T. Main	Mech. and Mill Engineer, Dean & Main	53 State St., 1112 Exchange Bldg., Boston, Mass.	Oct. 28, 1885.
Charles R. Makepeace	Mill Engineer	Box 973, Providence, R. I.	Apr. 30, 1890.
Vladimir Malinin, M. E.,	Prochoroff Three Hill Mfg. Co.	Moscow, Russia	Apr. 23, 1903.
Arthur B. Mann	J. H. Martin & Co.,	Box 465, 99 Franklin St., New York, N. Y.	Apr. 25, 1894.
Charles H. Manning	Supt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 28, 1885.
Henry F. Mansfield	Gen. Supt. Utica Steam Cotton Mills and Mohawk Valley Cotton Mills	Utica, N. Y.	Apr. 30, 1890.
Paul J. Marrs	Treas. Henderson Cotton Mills	Henderson, Ky.	Oct. 28, 1897.
Albert G. Martin	Supt. Kincaid Manufg. Co.	Box 182, Griffin, Spalding County, Ga.	Apr. 30, 1884.
Henry D. Martin	Supt. Danielson Cotton Mfg. Co.,	Danielson, Conn.	Apr. 28, 1897.

Arthur H. Mason	Treas. Barnaby Mfg. Co.	Fall River, Mass.	Oct. 2, 1902.
Philip A. Mathewson	Supt. King Philip Mills	Box 607, Fall River, Mass.	Apr. 24, 1895.
Scott Maxwell,	Agt. Indian Head Mills of Ala.	Cordova, Ala.	Sept. 26, 1901.
Thomas Mayor	Textile Machinery	Thomas Mayor & Son, 26 Olney St., Providence, R. I.	Oct. 27, 1880.
Robert McArthur	Agt. Pepperell Mfg. Co.	Biddeford, Me.	Apr. 17, 1872.
Thos. McAuliffe	Supt. Stevens Mfg. Co.	Fall River, Mass.	Apr. 27, 1898.
Henry G. McCarter	Mgr. John Farnum & Co., Conestoga Mills, 2 and 3	Lancaster, Pa.	Apr. 23, 1903.
Albert E. McDonald	Agt. Lawrenceville Mfg. Co.,	Lawrenceville, Ga.	Oct. 2, 1902.
Fred C. McDuffie	Treas. Everett Mills and York Manufg. Co.	P. O. Box 2934, 40 Water St., Boston, Mass.	Oct. 25, 1882.
James A. McLane	Supt. Davis Mills	Fall River, Mass.	Oct. 2, 1902.
William G. McLoon	Supt. Lancaster Mills,	Clinton, Mass.	Apr. 27, 1892.
Robert G. McMeehan,	Supt. Uncasville Mfg. Co.	Uncasville, Conn.	Sept. 26, 1901.
William P. McMullan	Agt. Naumkeag Steam Cotton Co.	Salem, Mass.	Sept. 27, 1894.
John Tempest Meats	Agt. Mason Machine Works	Taunton, Mass.	Apr. 27, 1887.
Robert B. Meikle	Supt. Lorraine Mfg. Co.	Westerly, R. I.	Apr. 23, 1903.
Henry P. Meikleham,	Agt. Mass. Mills in Georgia	Lindale, Floyd Co., Ga.	Apr. 26, 1900.
Joseph Mercer	Agt. and Treas. Willimantic Cotton Mills Co.	Willimantic, Conn.	Apr. 24, 1902.
Charles H. Merriman, Jr.	Manville Co., Board of Trade Bldg.,	Providence, R. I.	Apr. 24, 1895.
Joseph Merriam	Pres. Springfield Webbing Co.	Middletown, Conn.	Oct. 2, 1902.
W. H. Miles		Lisbon, Me.	Sept. 22, 1896.
R. M. Miller, Jr.	Pres. & Treas. Elizabeth Mills	Charlotte, N. C.	Sept. 29, 1898.
James I. Milliken	Agt. Everett Mills	Lawrence, Mass.	Oct. 26, 1892.
Roscoe S. Milliken	Agt. Nashua Mfg. Co.	Nashua, N. H.	Apr. 29, 1896.
David Milne	C. J. Milne & Sons	Washington Ave. & 10th and 11th Sts., Philadelphia, Pa.	Apr. 28, 1897.
A. B. Mole	Gen. Mgr. Dominion Cotton Mills Co.,	Montreal, P. Q.	Apr. 24, 1895.
Edward A. Mongeon	Supt. Lonsdale Mills	Lonsdale, R. I.	Apr. 24, 1895.
J. R. Montgomery	Pres. The J. R. Montgomery Co.	Windsor Locks, Conn.	Sept. 29, 1898.
George A. Moody	Supt. West Warren Cotton Mills	West Warren, Mass.	Apr. 27, 1899.
Fred W. Moore	Agt. Cordis Mills	P. O. Box 582, Millbury, Mass.	Apr. 27, 1892.
James Sumter Moore	Sec. and Treas. Olympia & Richland Cotton Mills	Columbia, S. C.	Apr. 26, 1900.
George B. Morison	Pres. Ballou Yarn Co.,	78 Chauncy St. Boston, Mass.	Apr. 24, 1895.
Albert H. Morton	Supt. Kitson Machine Co.	Lowell, Mass.	Oct. 28, 1891.
E. P. Morton,	Agt. Stevens Linen Works	Webster, Mass.	Sept. 26, 1901.
Oliver H. Moulton	Supt. Hamilton Manufg. Co.	Lowell, Mass.	Apr. 20, 1865.
Farquharson J. Muir	Mgr. Fort Mill Mfg. Co. and Millfort Mill Co.,	Fort Mill, S. C.,	Apr. 27, 1892.
John Neild	Agt. Grinnell Mfg. Corp.	New Bedford, Mass.	Apr. 25, 1901.
Will Nelson	Head Instructor of Weaving, Lowell Textile School	Lowell, Mass.	Apr. 23, 1903.

Roscius C. Newell . . . Supt. Palmer Mill . . . . . Three Rivers, Mass. . Oct. 25, 1895.
William G. Nichols . . Sec. and Treas. Springstein Mills and Pres. Wylie Mills . . . . . Chester, S. C. . . . . Oct. 25, 1893.
William M. Nixon . . . Pres. Atlanta Woolen Mills . . . . Atlanta, Ga. . . . . Oct. 5, 1899.
Albert W. Noone, . . . Prop. & Mgr. Jos. Noone's Son's Co. Peterboro, N. H. . . Sept. 26, 1901.
Franklin Nourse . . . Agt. Lawrence Manufg. Co. . . . . Lowell, Mass. . . . Apr. 24, 1878.

S. Odenheimer . . . . Treas. Lane Mills . . . . . New Orleans, La. . . Oct. 25, 1893.
Charles K. Oliver . . . Treas. . . . . Continental Bldg., Baltimore, Md. . . . Sept. 27, 1894.
J. Edward Osborn . . . Treas. American Linen Co. . . . . Fall River, Mass. . . Apr. 28, 1897.
Henry Osgood, ... 6 Monroe St., P. O. Box 204, Salem, Mass. . . . . Apr. 25, 1901.
Frederick Ott . . . . Supt. Hamlet Textile Co. . . . . Woonsocket, R. I. . . Apr. 23, 1903.
Herbert W. Owen . . Supt. Cocheco Mfg. Co. . . . . Dover, N. H. . . . . Oct. 5, 1899.
Oscar L. Owen . . . . Mech. and Mill Eng. Whitin Machine Works . . . . . Whitinsville, Mass. . Apr. 25, 1894.

Elmer E. Page . . . . Agt. York Manufg. Co. . . . . Saco, Me. . . . . Apr. 27, 1892.
O. B. Parker . . . . . Supt. Laurens Cotton Mills . . . . Laurens, S. C. . . . Apr. 24, 1895.
Samuel L. Parker . . . Supt. Turners Falls Cotton Mills . . . . . Box 627, Turners Falls, Mass. . Apr. 29, 1896.
Walter E. Parker . . . Agt. Pacific Mills, 217 Haverhill St., Lawrence, Mass. . . Apr. 25, 1877.
John H. Parks . . . . John H. Parks & Co., 93 Germain St., St. John, N. B. . . . Apr. 24, 1878.
Duncan D. Parmly . . Treas. Johnson Mfg. Co. and Dunbar Mills Co. . . . . 160 Broadway, New York, N. Y. . . Sept. 22, 1896.
Samuel F. Patterson . . Pres. and Treas. Thistle Mills Co. . Ilchester, Md. . . . Oct. 18, 1900.
John W. Pead . . . . Agt. Merrimack Manufg. Co. . . . . Box 1231, Lowell, Mass. . . . . Apr. 26, 1893.
James R. Pearce . . . . . 560 South Pryor St., Atlanta, Ga. . . . . Oct. 25, 1895.
William C. Peirce . . . Pres. Elizabeth Mills . 564 Eddy St., Providence, R. I. . . Apr. 24, 1895.
William D. Pennell . . Agt. Hill Manufg. Co. . . . . Lewiston, Me. . . . Apr. 16, 1873.
Haven C. Perham . . . Treas. Kitson Machine Co. . . . . Lowell, Mass. . . . Apr. 30, 1879.
Henry C. Phillips . . . Supt. Greylock Mills, ... North Adams, Mass. Apr. 25, 1894.
Benjamin Phipps . . . Merchant . . . . . 4 Winthrop Sq. Boston, Mass. . . . Sept. 29, 1898.
Albert R. Pierce . . . Supt. Pierce Mfg. Corp. . . . . New Bedford, Mass. . Oct. 5, 1899.
Andrew G. Pierce, Jr. . Treas. Pierce Manufg. Corp. . . . . P. O. Box, 34, New Bedford, Mass. . Apr. 24, 1895.
Reuben Pilling, Jr. . . . . 30 Hudson St., Providence, R. I. . . Apr. 29, 1896.
Charles H. Plummer . . Agt. Great Falls Manufg. Co. . . . Somersworth, N. H. . Apr. 25, 1888.
Charles T. Plunkett . . Sec. Berkshire Cotton Mfg. Co. . . Adams, Mass. . . . Apr. 28, 1897.
Charles H. Potter, . . . Supt. Montreal Cotton Co., ... Valleyfield, P. Q., . . Apr. 25, 1901.
Joseph H. Potter, Jr. . Supt. Durfee Mills . . . . . Fall River, Mass. . . Apr. 27, 1899.
J. F. Powers . . . . . Supt. Spinning Mill . . . . . Middletown, Conn. . Oct. 5, 1899.
Herbert L. Pratt . . . Agt. Bates Manufg. Co. . . . . Lewiston, Me. . . . Oct. 27, 1875.
George E. Prest . . . . . Worcester, Mass. . . Apr. 24, 1902.
Harry B. Prest . . . . . Worcester, Mass. . . Apr. 24, 1902.
John E. Prest . . . . . Worcester, Mass. . . Apr. 17, 1872.

M. W. Quinn . . . . . Agt. Hamilton Woolen Co. . . . . Amesbury, Mass. . . Oct. 27, 1886.

John W. Ramsbottom . Supt. Samoset Co. . . . . Valley Falls, R. I. . . Apr. 24, 1902.
Theodore Ellis Ramsdell, Agt. Monument Mills . . . . . Housatonic, Mass. . Apr. 23, 1903.
Emory S. Rathbun . . Supt. Pequot Mills . . . . . Montville, Conn. . . Apr. 27, 1899.
M. A. Rawlinson . . . Supt. Tremont and Suffolk Mills . . Lowell, Mass. . . . Apr. 24, 1895.
John F. Reardon . . . Supt. Millville Mfg. Co. . . . . Millville, N. J. . . . Apr. 26, 1900.
Robert Redford . . . Mfr. . . . . Box 28, Lawrence, Mass. . . Apr. 26, 1882.
R. S. Reinhardt . . . . Treas. and Mgr. Elm Grove Cotton Mills, Lincolnton, N. C. Apr. 27, 1898.
L. B. Renfrew . . . . Treas. Renfrew Mfg. Co. . . . . Adams, Mass. . . . Oct. 5, 1899.
T. H. Rennie . . . . . Supt. Graniteville Mfg. Co. . . . . Graniteville, S. C. . . Oct. 18, 1900.
Frederick W. Reynolds, Supt. Potomska Mills, ... Box 299, ...
. . . . . 20 Fifth St., New Bedford, Mass. . Apr. 26, 1900.
Francis H. Rice . . . . Pres. Holbrook Mfg. Co. . . . . Millbury, Mass. . . . Apr. 28, 1880.
John Bion Richards . . Treas. Davis Mills . . . . . Fall River, Mass. . . Apr. 24, 1902.
Charles H. Richardson Agt. Lancaster Mills . . . . . Clinton, Mass. . . . Apr. 24, 1889.
W. H. Richmond . . . Supt. Bibb Mill No. 2 . . . . . Macon, Ga. . . . . Oct. 28, 1897.
Walter Rigby . . . . Bibb Mfg. Co. . . 3163 First Ave., Columbus, Ga. . . . Apr. 26, 1900.
Charles E. Riley . . . Textile Machinery, C. E. Riley & Co. . . . . .
. . . . . 65 Franklin St., Box 2815, Boston, Mass. . . . Apr. 25, 1888.
William H. Ritter . . . Gen. Supt. and Buyer Johnson & Johnson . . . . . .
. . . . . 266 George St., New Brunswick, N. J. Apr. 26, 1900.
George W. Robbins . . Supt. Dyerville Mfg. Co., ...
. . . . . 610 Manton Ave., Providence, R. I. . . Apr. 28, 1897.
Benj. H. Roberts . . . General Mill Supplies 163 Grove St., Fall River, Mass. . . Apr. 26, 1900.
Charles D. Robinson . Supt. Crompton Co. . . . . Crompton, R. I. . . . Sept. 27, 1894.
Edwin A. Robinson . . Asst. Supt. Tremont and Suffolk Mills Lowell, Mass. . . . . Oct. 18, 1900.
William A. Robinson . Manville Co. . . . . Woonsocket, R. I. . Apr. 29, 1896.
William H. Robinson . Supt. No. 3 Harmony Mill . . . . Cohoes, N. Y. . . . Apr. 24, 1902.
W. H. Rose . . . . . Sec'y & Treas. Richland, Granby and Olympia Cotton Mills
. . . . . Columbia, S. C. . . . Oct. 18, 1900.
John R. Rostron . . . Lancaster Mills . . . . . Clinton, Mass. . . . Sept. 29, 1898.
John K. Russell . . . Pres. and Gen. Mgr. Messenger Mills Corp. . . . . .
. . . . . 476 Hall St., Manchester, N. H. . Apr. 29, 1891.

Alfred Sagar . . . . . Supt. Arlington Cotton Mills . . . . . .
. . . . . 15 High St., Methuen, Mass. . . Apr. 24, 1902.
Edward H. Sanborn . . Vice Pres. Cold Spring Bleaching and Finishing Works . .
. . . . . North American Bldg., Philadelphia, Pa. . . Oct. 18, 1900.
Richard W. B. Sanderson G. S. Lings & Co., Yarn Merchants . . . . . .
. . . . . P. O. Box 1323, Providence, R. I. . . Apr. 24, 1902.
Arnold B. Sanford . . Pres. Kennebec Spinning Mills . . . . . .
. . . . . 67 Chauncy St., Boston, Mass. . . . Oct. 25, 1882.
Pardon B. Sanford . . Supt. Utica Spinning Co. . . . . Utica, N. Y. . . . . Oct. 2, 1902.
J. Herbert Sawyer . . . . . 93 Federal St., Boston, Mass. . . . July 19, 1865.
George H. Sayward . . . . . Winchester, Mass. . Oct. 29, 1890.

Arnold Schaer	Agt. Warren Manufg. Co.	Warren, R. I.	Apr. 24, 1895.
Theodore C. Search	Pres. Cold Spring Bleaching and Finishing Works	Yardley, Pa.	Oct. 18, 1900.
Albion K. Searls	Supt. Yarn Dept., Oneita Knitting Mills	910 Bleecker St., Utica, N. Y.	Apr. 24, 1902.
Charles M. Sears	Supt. Harmony Grove Cotton Mills	Harmony Grove, Ga.,	Apr. 27, 1898.
George H. Shapley	Treas. Silver Lake Co., 78 Chauncy St.	Boston, Mass.	Apr. 29, 1896.
Frank P. Sheldon	Mill Engineer and Architect	Industrial Trust Bldg. Providence, R. I.	Apr. 25, 1894.
Thomas C. Sheldon	Agt. Fitchburg Duck Mills	8 School St., Fitchburg, Mass.	Oct. 29, 1884.
Willis S. Shepard	Pres. American Net and Twine Co.	Canton, Mass.	Apr. 29, 1896.
William F. Sherman	Mill Engineer	107 New Brazer Bldg., 27 State St., Boston, Mass.	Apr. 15, 1874.
Charles M. Shove	Treas. Granite Mills	Box 45, Fall River, Mass.	Oct. 27, 1875.
Herbert H. Shumway	Treas. and Agt. Corr Manufg. Co.	Taunton, Mass.	Apr. 26, 1893.
Francis H. Silsbee	Supt. Cotton Dept. Pacific Mills	Lawrence, Mass.	Apr. 27, 1887.
Nathaniel G. Simonds	Treas. Naumkeag Steam Cotton Co.,	Salem, Mass.	Apr. 27, 1898.
Louis Simpson		Victoria Chambers, Ottawa, Ont.	Apr. 24, 1895.
Abbott E. Slade	Treas. Laurel Lake Mills	863 High St., Fall River, Mass.	Oct. 25, 1893.
Arthur T. Smith	Supt. Langley Manufg Co. Supt. Aiken Manufg. Co.	Langley, S. C.	Oct. 25, 1895.
James Herbert Smith	Supt. Quinebaug Co.	Danielson, Conn.	Apr. 27, 1898.
Joel Smith	Supt. The J. P. King Manufg. Co.	Augusta, Ga.	Oct. 25, 1895.
J. C. Smith	Supt. Chace Mills	Fall River, Mass.	Oct. 28, 1897.
Thomas Henry Smith	Jamestown Cotton Mill	Jamestown, N. Y.	Apr. 30, 1884.
Ellison A. Smyth	Pres. Pelzer Manufg. Co.	Pelzer, S. C.	Oct. 26, 1892.
William S. Southworth	Agt. Mass. Cotton Mills	Box 1230, Lowell, Mass.	Oct. 31, 1888.
Wilton H. Spencer	Textile Manuf.,	7 Exchange Pl., Providence, R. I.	Apr. 27, 1898.
George E. Spofford	Supt. Blackstone Mfg. Co.	Blackstone, Mass.	Apr. 29, 1896.
Henry B. Sprague	Treas. Boston Woven Hose and Rubber Co.	Lynn, Mass.	Oct. 5, 1899.
Leroy Springs	Pres. Lancaster Cotton Mills	Lancaster, S. C.	Oct. 25, 1895.
George R. Stearns	Pres. Riverside Mills	Augusta, Ga.	Apr. 30, 1890.
T. B. Stevenson	Supt. Manchang Co.	Manchang, Mass.	Apr. 26, 1900.
Robert Stewart	Supt. Ashton Mill	Ashton, R. I..	Apr. 27, 1899.
Samuel Stewart	Supt. Boston Duck Co.	Bondsville, Mass.	Apr. 23, 1903.
William J. Stewart	Supt. H. N. Slater Mills	Webster, Mass.	Apr. 23, 1903.
Walter F. Stiles	Treas. Orswell Mills	Fitchburg, Mass.	Oct. 25, 1895.
O. W. Stites	Elliott Fuel Saving Co.	Durham, N. C.	Oct. 25, 1895.
B. L. Stowe	Vice-Pres. Eureka Fire Hose Co.	Wilkinson and Arlington Aves., Jersey City, N. J.	Sept. 26, 1901.
Herman F. Straw	Agt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 28, 1885.
John Sullivan	Supt. Union Cotton Mfg. Co.	Fall River, Mass.	Apr. 27, 1899.
Timothy Sullivan	Supt. Stafford Mills	Fall River, Mass.	Apr. 27, 1899.

Walter H. Summersby . Agt. Atlantic Cotton Mills . . . . Lawrence, Mass. . . Oct. 25, 1893.
D. G. Sunderland . . . Treas. The Pelham Mills . . . . . Pelham, S. C. . . . . Oct. 18, 1900.
James O. Sweet . . . . Agt. and Treas. Ashland Cotton Co. Jewett City, Conn. . Apr. 28, 1886.

Robert Rennie Taft . . . . . P. O. Box 1443, Providence, R. I. . . Apr. 24, 1895.
Robert W. Taft . . . . Treas. Coventry Co. and Bernon Mills . . . . . Box 1144, Providence, R. I. . . Sept. 27, 1894.
George P. Taylor . . . Treas. Danielsonville Cotton Co. of Danielson, Conn. . . . . 286 Chestnut St., Clinton, Mass. . . . Oct. 27, 1880.
James W. Taylor . . . Agt. Canoe River Mills . . Box 46, Taunton, Mass. . . . Oct. 26, 1892.
W. Marshall Taylor . . Gen. Mgr. National Flax Fibre Co. . . . . Box 327, Millis, Mass. . . . . Sept. 22, 1896.
Richard Thackeray . . Supt. Weetamoe Mills . . . . . Fall River, Mass. . . Apr. 29, 1885.
S. Willard Thayer . . . Treas. Dexter Yarn Co. . . . . Pawtucket, R. I. . . Sept. 26, 1901.
Earl A. Thissell . . . . Treas. Lowell Hosiery Co. . . . . Lowell, Mass. . . . Oct. 30, 1878.
Ariel C. Thomas . . . Agt. Boott Cotton Mills . . . . . 62 Mt. Vernon St., Lowell, Mass. . . . Oct. 31, 1888.
Charles E. Thomas . . Treas. and Agt. Forestdale Manufg. Co. . . . . 44 Prospect St., Woonsocket, R. I. . . Oct. 31, 1883.
Edward W. Thomas . . . . . Buford Hotel, Charlotte, N. C. . . . Apr. 30, 1884.
D. M. Thompson . . . Gen. Mgr. B. B. and R. Knight's Mills . . . . . Box 1442, Providence, R. I. . . Oct. 28, 1885.
James O. Thompson, Jr. Supt. Wamsutta Mills . . . . . New Bedford, Mass. . Oct. 18, 1900.
Ralph E. Thomson . . Supt. Parkhill Manufg. Co., Mill C. Fitchburg, Mass. . . Apr. 25, 1894.
Joseph S. Tidd . . . . Treas. Oakland Mills . . . . . Taunton, Mass. . . . Apr. 27, 1899.
Horace W. Tinkham . Treas. and Agt. Robeson Mills , . . Fall River, Mass. . . Apr. 27, 1899.
R. Irving Tobey . . . Mgr. Cold Spring Bleaching and Finishing Works . . . . . Yardley, Pa. . . . . Oct. 2, 1902.
W. O. Todd . . . . . Sec. and Treas. Lawton Spinning Co. Box 1125, ... 621 Banigan Building, Providence, R. I. . . Oct. 18, 1900.
James P. Tolman . . . Pres. Samson Cordage Works . . . . . 115 Congress St., Boston, Mass. . . . Oct. 29, 1890.
Daniel A. Tompkins . Pres. D. A. Tompkins Co. . . . . Charlotte, N. C. . . . Oct. 25, 1895.
M. J. Toohey . . . . Mfr. Rope, Twine and Banding . . . . . 809 Stafford Rd., Fall River, Mass . . Oct. 2, 1902.
George W. Towne . . . Mgr. Columbus Power Co. . . . . Columbus, Ga. . . . Oct. 26, 1892.
Edward B. Townsend, . Treas. Warwick Mills, ... 27 Kilby St., Boston, Mass. . . . Apr. 25, 1901.
D. Irving Trainer . . . Agt. Lincoln Mfg. Co. . . . . Chester, Pa. . . . . Apr. 23, 1903.
Robert B. Treat . . . . Prop. Centreville Cotton Mills . . . Centreville, R. I. . . Sept. 27, 1894.
C. H. Truesdell . . . . Supt. Attawaugan Co. . . . . Killingly, Conn. . . Oct. 29, 1884.
Edmund E. Truesdell . Supt. China, Webster & Pembroke Mills . Suncook, N. H. . Apr. 26, 1876.
Oscar B. Truesdell . . . . . 18 Washington Terrace, Newtonville, Mass. . Oct. 15, 1873.
George E. Tucker . . . Agt. Otis Co. . . . . Ware, Mass. . . . . Oct. 25, 1895.
Philip S. Tuley . . . Pres. and Treas. Louisville Cotton Mills Co. . . . . 1008 Goss Ave., Louisville, Ky. . . . Oct. 18, 1900.

George W. Turner . . Supt. Argo Mills Co. . . . . Gloucester City, N. J. Apr. 26, 1900.
William D. Twiss . . . Supt. Everett Mills . . . . . Lawrence, Mass. . . April 29, 1896.

Charles T. Upton . . . . . 63 Mt. Vernon St., Lowell, Mass. . . . Apr. 28, 1897.

George A. Vaughan . . Supt. The Putnam Manufg. Co. . . Putnam, Conn. . . . Sept. 22, 1896.
William P. Vaughan . Agt. Putnam Manufacturing Co. . . . . 1041 Banigan Building, Providence, R. I. . . Sept. 29, 1898.
Eugene F. Verdery . . Pres. and Treas. Warren Mfg. Co. . . . . 739 Reynolds St., Augusta, Ga. . . . . Apr. 26, 1900.
Frank P. Vogl . . . . Agt. Monadnock Mills . . . . . Claremont, N. H. . . Sept. 27, 1894.

Jude C. Wadleigh . . . Supt. Mass. Cotton Mills . . . . . Lowell, Mass. . . . Oct. 26, 1892.
Herbert E. Walmsley . Agt. Wamsutta Mills . . . . . New Bedford, Mass. . Oct. 29, 1890.
Robinson Walmsley . . Supt. Tecumseh Mills, P. O. Box 246, Fall River, Mass. . . Apr. 27, 1899.
Frederick T. Walsh . . Mgr. Thomas Leyland & Co., Dyestuffs, etc. . . . . 195 Nesmith St., Lowell, Mass. . . . Apr. 28, 1897.
James A. Walsh . . . Agt. Lewiston Bleachery and Dye Works . . . . . Lewiston, Me. . . . Apr. 27, 1892.
Joseph Watters . . . . Supt. Osborn Mills . . . . . Fall River, Mass. . . Oct. 15, 1873.
F. E. Wattles . . . . Agt. Boscawen Mills . . . . . Penacook, N. H. . . Oct. 5, 1899.
W. B. Smith Whaley . Mechanical & Mill Engineer, Pres. Richland Cotton Mills, ... Granby Cotton Mills, 1012 Tremont Bldg., Boston, Mass, ... 1328 Main St., Columbia, S. C. . . Apr. 24, 1895.
H. D. Wheat . . . . . Pres. and Treas. Gaffney Mfg. Co. and Pres. and Treas. . . . . Orient Mfg. Co. . . . . Gaffney, S. C. . . . Apr. 24, 1895.
Channing Whitaker . . Infringement and Patentability of Inventions . . . . . Lowell Machine Shop . . . . . Lowell, Mass. . . . Oct. 15, 1873.
A. Tenny White . . . Supt. Manville Co. . . . . Manville, R. I. . . . Oct. 27, 1887.
Alphonso F. White . . Supt. Forestdale Mfg. Co., ... Forestdale, R. I. . . Apr. 24, 1902.
Charles D. White . . . Agt. Uncasville Mfg. Co. . . . . Norwich, Conn. . . . Oct. 28, 1897.
Arthur F. Whitin . . . Pres. and Treas. Saunders Cotton Mills . . . . . Whitinsville, Mass. . Apr. 24, 1895.
Fred B. Whitin . . . . . Linwood, Mass. . . Apr. 28, 1897.
Henry T. Whitin . . . Treas. Paul Whitin Manufg. Co. . . Northbridge, Mass. . Apr. 25, 1877.
James Earle Whitin . . Pres. Uxbridge Cotton Mills . . . . Whitinsville, Mass . . Apr. 23, 1903.
Alfred N. Whiting . . Sec. and Treas. L. M. Harris Manufg. Co. . . . . 167 Pleasant St., Worcester, Mass. . . Apr. 21, 1875.
William Whitman . . Pres. Arlington Mills . . . . . P. O. Box 100, Essex St. Station, Boston, Mass. . . . . Apr. 25, 1901.
William S. Whitney . . Supervising Engineer, American Woolen Co. . . . . Lawrence, Mass. . . Apr. 24, 1878.
Arthur Whittam . . . Director Miss. Textile School and Pres. John M. Stone Cotton Mills . . . . . Starkville, Miss., . . Apr. 27, 1898.

William Whittam, Jr. . Vice Pres. & Gen. Mgr. The William Whittam Textile Co. . . . . Ashville, N. C. . . . Apr. 26, 1893.
George F. Whitten . . Agt. Amory Mfg. Co. . . . . Manchester, N. H. . Oct. 26, 1892.
John H. Whitten . . . Agt. Stark Mills . . . . . Manchester, N. H. . Apr. 27, 1898.
Nelson Whittier . . . Treas. Whittier Mills . . . . . Springfield, Mass. . . Oct. 18, 1900.
W. R. B. Whittier . . Mgr. Whittier Mills . . . Chattahoochee, Fulton Co., Ga. . Oct. 18, 1900.
George A. Wies . . . . Treas. Eureka Fire Hose Co. . . . . 13 Barclay St., New York City . . . Apr. 24, 1902.
Edward B. Wilbur . . Gen. Mgr. & Supt. Mollohon Mfg. Co. Newberrry, S. C. . . . Oct. 30, 1889.
Benjamin Wilcox . . . Treas. City and Bristol Mfg. Co. . . New Bedford, Mass. . Apr. 26, 1900.
Henry M. Wilcox . . . Treas. John Rhodes Warp Co. . . . Millbury, Mass. . . . Apr. 24, 1889.
John B. Wild . . . . Pres. Oneita Knitting Mills . . . . Utica, N. Y. . . . . Apr. 26, 1900.
Eben C. Willey . . . . . 85 Pembroke St., Boston, Mass. . . . Apr. 29, 1896.
Franklin D. Williams . Treas. Fiskdale Mills, ... 87 Milk St., Room 21, Boston, Mass. . . . . Apr. 25, 1901.
Henry Williams . . . Supt. Canoe River Mill . . . . . Taunton, Mass. . . . Apr. 23, 1903.
Broadus E. Willingham, Sec. and Treas. Willingham Cotton Mills . . . . . Macon, Ga. . . . . Oct. 18, 1900.
Elias S. Willis . . . . Supt. Boott Cotton Mills . . . . Lowell, Mass. . . . Apr. 23, 1903.
Theop. W. Wilmarth . N. E. Cotton Yarn Co. . . . . 264 Pleasant St., New Bedford, Mass. . Oct. 31, 1883.
William E. Winchester . Teacher of Cotton Carding and Spinning, Philadelphia Textile School, Broad and Pine Sts., Philadelphia, Pa. . . Apr. 24, 1902.
Samuel F. Winsper . . Supt. City Mfg. Co. . . . . New Bedford, Mass. . Apr. 23, 1903.
George Wood . . . . Pres. and Treas. Millville Manufg. Co. . . . . 626 Chestnut St., Phila., Pa. . . . . Oct. 16, 1872.
John P. Wood . . . . . 521 N. 22d St., Philadelphia, Pa. . . Apr. 28, 1897.
Oscar W. Wood . . . Treas. Germantown Spinning Co. . . . . Germantown, Philadelphia, Pa. . . Oct. 18, 1900.
C. J. H. Woodbury . . Secretary and Treasurer . . . . . Lynn, Mass. . . . . Oct. 29, 1879.
Wm. I. Woodward . . Agt. Shetucket Co., ... Norwich, Conn. . . Apr. 23, 1903.

Adelbert R. Young . . Supt. Ashland Cotton Co. . . . . Jewett City, Conn. . . Apr. 25, 1894.
James M. Young . . . Mgr. Hamilton Cotton Co. . . . . Hamilton, Ont., Can. Apr. 27, 1899.

ASSOCIATE MEMBERS.

S. B. Alexander, Jr. . . Pres. S. B. Alexander, Jr. Co. . . . Charlotte, N. C. . . . Oct. 18, 1900.
Eugene C. Andres . . Exporter and Importer . . . . . 517 John Hancock Building, Boston, Mass. . . . . Oct. 18, 1900.
Henry B. Ashton . . . Agt. S. A. Felton & Son Co. . . . . Manet Road, Newton, Mass. . . . Apr. 26, 1900.
Henry Ashworth . . . Agt. of Elijah Ashworth, Mfr. of Card Clothing . . . . . 89 Globe Mills Ave., Box 427, Fall River, Mass. . . Apr. 28, 1897.

George R. Babbitt . . . Pres. and Gen. Mgr. American Oil Co. . . . . 182 So. Water St., Providence, R. I. . . Apr. 24, 1895.
D. C. Ball . . . . . 5 Beekman St., New York, N. Y. . . Oct. 25, 1895.
Edwin Barnes . . . . Vice Pres. Wm. Firth Co. . . . . 67 Equitable Building, Boston, Mass. . . . . Apr. 26, 1900.
George S. Barnum . . Sec. and Treas. The Bigelow Co. . New Haven, Conn. . Apr. 24, 1895.
Colin C. Bell . . . . Vice-Pres. American Vulcanized Fibre Co. . . . . No. Cambridge, Mass. Apr. 29, 1896.
Frank P. Bennett . . . Publisher American Wool and Cotton Reporter . . . . . 530 Atlantic Ave., Boston, Mass. . . . Sept. 22, 1896.
William H. Bent . . . Treas. Mason Machine Works . . . Taunton, Mass. . . . April 29, 1896.
Edward H. Best . . . Woolen Merchant, 224 Purchase St., Boston, Mass. . . Apr. 23, 1903.
Albert Birch . . . . . Prop. Somerville Machine Works, ... 32 Kent St., Somerville, Mass. . . . Oct. 2, 1902.
F. H. Bishop . . . . . Gen. Mgr. Universal Winding Co. . . . . 95 South St., Boston, Mass. . . . . Apr. 26, 1900.
Edmund E. Blake . . Selling Agt. Saco & Pettee Machine Shops . . . . . Newton Upper Falls, Mass. Oct. 2, 1902.
Arthur T. Bradlee, . . Mgr. Cotton Yarn Dept., Harding, Whitman & Co. . . . . 78 Chauncy St., Boston, Mass. . . . . Apr. 25, 1901.
J. Payson Bradley . . . The Kehew Bradley Co. . . . . 24 Purchase St., Boston, Mass. . . . Apr. 24, 1895.
J. Frank Braids . . Mgr. Grease & Oil Dept., Charles S. Bush Co. . . . . Box 20, 212 Weybosset St., Providence, R. I. . . Apr. 28, 1897.
Henry Gordon Brinckerhoff, N. E. Mgr. Green Fuel Economizer Co., Box 2654 . . . . . Room 1053, Exchange Bldg., 53 State St., Boston, Mass. Sept. 22, 1896.
H. Martin Brown . . . Treas. U. S. Bobbin & Shuttle Co. . Providence, R. I. . . Apr. 24, 1895.
George L. Brownell . . Inventor and Builder of Improved Twisting Machinery . . . . . Station A, Worcester, Mass. . . Apr. 23, 1903.
Percy H. Brundage . . . . . 49 Wall St., New York, N. Y. . . Oct. 5, 1899.
John H. Burghardt . . Page Belting Co. . . . 31 Pearl St., Boston, Mass. . . . Apr. 24, 1895.
Eugene E. Burnham . . Belt Mfr. . . . . 252 Lowell St., Lawrence, Mass. . . Oct. 25, 1895.
Fred N. Bushnell . . . Chief Engineer, Rhode Island Co. . Providence, R. I. . . Sept. 29, 1898.
Harry W. Butterworth . Sec. H. W. Butterworth & Sons . . . . . York and Cedar Sts., Philadelphia, Pa. . . Oct. 28, 1897.
James Butterworth . Pres. H. W. Butterworth & Sons . . . . . York and Cedar Sts., Philadelphia, Pa. . . Apr. 24, 1895.

Albert L. Calder, 2nd . Cotton Dealer . . . . . 28 Market Square, Box 206, Providence, R. I. . . Apr. 26, 1900.
French Campbell . . . Mgr. Yarn Dept., Care of James Freeman Brown Co. . . . . Box 132, New York, N. Y. . . Oct. 28, 1897.
Malcolm Campbell . . Gen. Mgr. Woonsocket Machine and Press Co. . . . . Woonsocket, R. I. . . Apr. 24, 1895
W. W. Carey . . . . . Mfr. Wood Rim Pulleys and Wood Working Machinery . . . . . 514 Broadway, Lowell, Mass. . . . . Apr. 24, 1895.

Albert C. Case . . . . . 25 Broad St., Room 1213, New York, N. Y. . . Sept. 26, 1901.
J. E. Cheesman . . . . Pres. Cheesman Cotton Gin Co. . . . . 76 William St., New York, N. Y. . . Oct. 5, 1899.
Charles H. Child . . . Treas. Standard Mill Supply Co. . . . . P. O. Box 1426, 77 Exchange Place, Providence, R. I. . . Apr. 24, 1895.
Melvin H. Coffin . . . Selling Agt. Whitin Machine Works Whitinsville, Mass. . Oct. 2, 1902.
C. C. Cowan . . . . . 27 William St., New York, N. Y. . . Oct. 5, 1899.
Thomas G. Cox . . . . Selling Agt. Mason Machine Works . . . . . Box 316, Taunton, Mass. . . . Apr. 24, 1895.
C. F. Curwen . . . . Treas. Dinsmore Mfg. Co. . . . . Salem, Mass. . . . . Apr. 27, 1899.
Joseph L. Cushing . . Mfr. of Cotton Conveying Systems, Daniel Cushing & Co., ... Box 885, Lowell, Mass. . . . . Apr. 26, 1900.

Frederick I. Dana . . . Gen. Sales Mgr., The Textile Machinery Finishing Co. . . . . Providence, R. I. . . Apr. 24, 1895.
Charles Henry Davis . C. E., Charles Henry Davis & Partners, ... 25 Broad St., New York, N. Y. . . Apr. 23, 1903.
Hugh De Haven . . Prop. De Haven Mfg. Co. . . . . 50-54 Columbia Heights, Brooklyn, N. Y. . . Apr. 23, 1903.
John O. DeWolf, . . . Mech. Engineer W. B. Smith Whaley & Co. . . . . 1012 Tremont Bldg., Boston, Mass. . . . Apr. 25, 1901.
C. E. W. Dow . . . . Agt. American Moistening Co. & Wm. Firth Co. . . . . 150 Devonshire St., Boston, Mass. . . . Apr. 24, 1895.
Frederick A. Downes . Sec. Factory Mutual Fire Insurance Cos. . . . . 925 Chestnut St., Philadelphia, Pa. . . Oct. 28, 1897.
W. L. Draper . . . . Mgr. Dodge Mfg. Co. . . . . Atlanta Branch, 507 Prudential Building, Atlanta, Ga. . . . . Oct. 18, 1900.

Fred W. Easton, . . . Treas. Easton & Burnham Machine Co., ... 180 Weeden St., Pawtucket, R. I. . . Apr. 25, 1901.
William Dresser Edwards New Eng. Mgr. Buffalo Forge Co. . . . . Board of Trade Bldg., Boston, Mass. . . . Oct. 2, 1902.
G. B. Emmons . . . . Pres. Emmons Loom Harness Co. . . . . May St., Lawrence, Mass. . . Oct. 25, 1895.

D. D. Felton . . . . . Treas. S. A. Felton & Son Co. . . . Manchester, N. H. . Apr. 24, 1895.
John W. Ferguson . . Contractor . . . . . Paterson Nat. Bank Bldg., Paterson, N. J. . . . Apr. 24, 1895.
L. L. Flemming . . . Vice-Pres. and Gen. Mgr. American Cotton Co. . . . . 25 Broad St., Lock Box 240, New York, N. Y. . . Apr. 23, 1903.
J. Herbert Foster . . . Cotton Broker . 10 South Water St., Providence, R. I. . . Apr. 24, 1895.
Merrill A. Furbush . . . . . 2015 North 33rd St., Philadelphia, Pa. . . Oct. 28, 1897.
John T. Fyans . . . . Agt. Fyans, Frazer & Blackway Co. . . . . 411 Beach St., Fall River, Mass. . . Apr. 28, 1897.

H. P. Garland . . . . Treas. Loom Picker Co. . . . . Biddeford, Me. . . . Oct. 25, 1895.
Royal W. Gates . . . . Josiah Gates & Sons, Belting . . . . . .
. . . . . 75 Gates St., Lowell, Mass. . . . Apr. 24, 1895.
Rufus B. Goff . . . . Pres. Standard Mill Supply Co. . . . . .
. . . . . 77 Exchange Pl., Box 714, Providence, R. I. . . . Apr. 28, 1897.
Henry T. Grant . . . Pres. Mercantile Mutual Fire Ins. Co. . . . . .
. . . . . Box 1153, 723 Banigan Building, Providence, R. I. . . . Oct. 28, 1897.
Arthur F. Gray . . . . Architect and Mill Engineer . . . . . .
. . . . . 53 State St., Room 509, Boston, Mass. . . . Oct. 18, 1900.
Samuel M. Green, M. E. The American Thread Co. . . . . Holyoke, Mass. . . . Apr. 24, 1902.
Edwin Farnham Greene Pres. Lockwood, Greene & Co. . . . . .
. . . . . 93 Federal St., Boston, Mass. . . . Apr. 24, 1902.

A. Walter Harris . . . Treas. A. W. Harris Oil Co. . . . . .
. . . . . 326 So. Water St., Providence, R. I. . . . Oct. 25, 1895.
Alfred H. Hartley . . Dealer in Oils and Mill Supplies . . . . . .
. . . . . Box 409, Fall River, Mass. . . . Oct. 28, 1897.
Charles C. Hedrick . . Mech. Eng. Lowell Machine Shop . Lowell, Mass. . . . Apr. 23, 1903.
Jerome Hill . . . . . Pres. Jerome Hill Cotton Co. . . . . .
. . . . . 334 Front St., Memphis, Tenn. . . . Apr. 29, 1896.
Richard H. Hill . . . Gen. Sales Agt. James Hunter Machine Co. . . . . .
. . . . . 70 Kilby St., Boston, Mass. . . . . Apr. 26, 1900.
Alfred K. Hobbs . . . Rubber, Leather and Mill Supplies . Manchester, N. H. . Oct. 18, 1900.
John Hogg . . . . . Smith, Hogg & Gardiner, 144 Essex St., Boston, Mass. . . . Apr. 27, 1899.
Henry A. Holcomb . . . . . Box 249, New Bedford, Mass. . Oct. 25, 1895.
Henry S. Houghton, Sr., Mfr. Grids and Beaters, 61 Pond St., Woonsocket, R. I. . Apr. 28, 1897.
Lewis T. Houghton . . Mfr. Appliances for Cotton Machinery . . . . . .
. . . . . 997 Main St., Worcester, Mass. . . Sept. 26, 1901.
A. H. Howard . . . . Treas. Howard Bros. Mfg. Co. . . . . .
. . . . . P. O. Box 54, Worcester, Mass. . . Sept. 26, 1901.
Frederic W. Howe . . Salesman Crompton & Knowles Loom Works . . . . . .
. . . . . Box 899, Providence, R. I. . . . Apr. 24, 1902.
Lemuel R. Howe . . . Importer & Dealer in Dye Stuffs, Howe, Fuller & Trunkett,
. . . . . 157 Federal St., Boston, Mass. . . . Apr. 25, 1901.
C. H. Hutchins . . . . Pres. Crompton & Knowles Loom Works . . . . . .
. . . . . Worcester, Mass. . . Oct. 25, 1895.

Daniel Jackson . . . . Cotton Buyer B. B. and R. Knight, . Providence, R. I. . . . Apr. 24, 1902.
David Jackson . . . . Gen. Mgr. Jackson Pat. Shell Roll Co., Pawtucket, R. I. . . . Apr. 24, 1895.

Lawrence M. Keeler . Whitin Machine Works . . . . . Whitinsville, Mass. . Sept. 26, 1901.
William B. Kehew . . The Kehew-Bradley Co., ...
. . . . . 24 Purchase St., Boston, Mass. . . . Apr. 24, 1895.
James H. Kendall . . Edward Kendall & Sons . . . . . Cambridgeport, Mass., Sept. 29, 1898.
John E. Kendrick . . . Pres. American Supply Co., Box 822, Providence, R. I. . . . Oct. 5, 1899.
Frank B. Kenney . . . Mgr. Care of T. C. Entwistle Co. . . . . .
. . . . . 297 Market St., Lowell, Mass. . . . Oct. 5, 1899.

W. C. Langford . . . Salesman, . . . 86 Weybosset St., Providence, R. I. . . . Apr. 27, 1899.
Josiah M. Lasell . . . Asst. Treas. Whitin Machine Works, Whitinsville, Mass. . Apr. 24, 1895.
Samuel D. Lawton . . Treas. Fall River Machine Co. . . . Fall River, Mass. . . Oct. 18, 1900.
John H. Lorimer . . . Builder of Textile Machines . . . . . Ontario and Lawrence Sts., Philadelphia, Pa. . . Oct. 28, 1897.
Sanford E. Loring . . Con. Architect, 341 Delaware St., . Syracuse, N. Y. . . Apr. 24, 1902.
Stephen C. Lowe . . . Agt. John Hetherington & Sons, Ltd., ... 186 Devonshire St., Boston, Mass. . . . Oct. 25, 1895.

Francis E. Macomber . Mill Supplies . . . . 21 Pearl St., Boston, Mass. . . . . Apr. 26, 1900.
Fay H. Martin . . . . Pres. Textile Machinery Co. . . . . 66 State St., Boston, Mass. . . . . Sept. 26, 1901.
F. H. Maynard . . . . Gen. Bus. Mgr. Gen. Fire Extinguisher Co. . . . . Providence, R. I. . . . Apr. 24, 1895.
John McCullough, . . . Cotton Waste Merchant . . . . . New Bedford, Mass. . April 25, 1901.
D. E. McGaw . . . . Gen. Mgr. Aragon Mills . . . . . Aragon, Ga. . . . . Oct. 18, 1900.
H. G. McKerrow . . . Textile Machinery Importer . . . . . 31 State St., Boston, Mass. . . . Sept. 22, 1896.
D. K. McLaren . . . . Mfr. of Leather Belting 751 Craig St., Montreal, P. Q., Can. Apr. 26, 1900.
John R. Mitchell . . . Mitchell-Bissell Co., 362 Bourse Bldg., Philadelphia, Pa. . . Oct. 18, 1900.
Charles B. Moore . . . Mgr. Knowles Steam Pump Works . . . . . 54 Oliver St., Boston, Mass. . . . . Apr. 26, 1900.

Robert W. Neff . . . . Chemical Mfr. . . . . 22 India Sq., Boston, Mass. . . . Apr. 24, 1902.
John H. Nelson . . . . Treas. William Firth Co. . . . . 60 Baltimore St., Lynn, Mass. . . . . Apr. 26, 1900.
William R. Noone . . . . . 102 South St., Boston, Mass. . . . Oct. 28, 1897.

Sidney B. Paine . . . General Electric Co., 200 Summer St., Boston, Mass. . . . Apr. 24, 1895.
William F. Parish, Jr. . Chief, Vacuum Oil Co. (Technical Department) . . . . . York House, Norfolk, London, W. C., England, Apr. 24, 1902.
Arthur Parkinson . . . Selling Agt. Arabol Mfg. Co. . . . . 13 Gold St., New York, N. Y. . . Apr. 28, 1897.
Stephen Minot Pitman . Sec'y Narragansett Mutual Fire Insurance Co. . . . . 721 Banigan Bldg., Box 315, Providence, R. I. . . Apr. 24, 1895.
Vladimir P. Polevoy . . Agent Jaroslav Cotton Mill, Russia . 120 Broadway, N. Y. Apr. 28, 1897.
Charles A. M. Praray . Chas. A. M. Praray & Co., Architect and Mill Engineer . . . . . 832 and 833 Banigan Building, Providence, R. I. . . Apr. 28, 1897.
Theodore H. Price . . Cotton Dealer . . . . 71 Wall St., New York, N. Y. . . Oct. 2, 1902.

Charles F. Randall . . Expert in Textiles . . . . . Room 350, Tremont Building, Boston, Mass. . . . Apr. 24, 1895.
Peleg A. Rhodes . . . Sec. Cotton Mill Mutual Fire Insurance Co. . . . . Augusta, Ga. . . . . Oct. 5, 1899.

Richard H. Rice . . . Treas. Providence Engineering Works . . . . . 521 So. Main St., Providence, R. I. . . . Apr. 24, 1895.

E. R. Richardson . . . Asst. Treas. Howard & Bullough American Machine Co., Ltd. . . . . Box 678, Pawtucket, R. I. . . . Apr. 26, 1900.

C. E. Roberts . . . . Mgr. Hartford Steam Boiler Inspection & Insurance Co. . . . . 101 Milk St., Room 400, Boston, Mass. . . . Apr. 24, 1895.

Louis E. Robinson . . Cotton Agent Sea Island Cotton . . . . . 36 So. Water St., Providence, R. I. . . . Oct. 28, 1897.

George I. Rockwood, . Mechanical Engineer, 62 Summer St., Worcester, Mass. . . . Apr. 25, 1901.

John M. Russell . . . . Treas. Crompton & Knowles Loom Works . . . . . Worcester, Mass. . . . Oct. 25, 1895.

Dwight Seabury . . . Mill Engineer . . . 12 East Ave., Pawtucket, R. I. . . . Apr. 25, 1901.

William N. Shaw . . . Treas. The Lincoln Iron Works and Jackson Architectural . . . . . Iron Works . . 315 E. 28th St., New York, N. Y. . . . Apr. 24, 1902.

J. A. Shepherd . . . . Sales Agt. The Stirling Co. . . . . 53 State St., Room 631, Exchange Building, Boston, Mass. . . . Oct. 18, 1900.

Harry M. Smith . . . Vice-Pres. Standard Mill Supply Co. . . . . 77 Exchange Pl., Box 714, Providence, R. I. . . . Apr. 28, 1897.

R. Paul Snelling . . . Treas. Saco and Pettee Machine Shops . . . . . Newton Upper Falls, Mass. . Sept. 22, 1896.

Henry C. Spence . . . Gen. Mgr. Metallic Drawing Roll Co. Indian Orchard, Mass. Apr. 24, 1895.

George W. Stafford . . Pres. Geo. W. Stafford Co. . . . . Readville, Mass. . . Apr. 24, 1895.

H. E. Stafford . . . . Agt. Geo. W. Stafford Co. . . . . Readville, Mass. . . Oct. 18, 1900.

James Strang . . . . Selling Agt. Metallic Drawing Roll Co. . . . . 123 Hampden St., Indian Orchard, Mass. Oct. 28, 1897.

William H. Stratton . . Mgr. Factory Insurance Association . . . . . 95 Pearl St., Hartford, Conn. . . Apr. 28, 1897.

Daniel J. Sully . . . . Cotton Broker, T. M. Reynolds & Co., ... 34 South Water St., Providence, R. I. . . . Apr. 24, 1895.

John Sykes, J. P. . . . Pres. English Card Clothing Co. . . . . Acre House, Huddersfield, Eng. . Oct. 18, 1900.

Cyrus A. Taft . . . . Agt. Whitin Machine Works . . . Whitinsville, Mass. . Apr. 24, 1895.

Charles F. Taylor . . . Prop. Burgess Cop Tube Co., ... 15 Custom House St., Providence, R. I. . . . Apr. 27, 1898.

Elwood E. Taylor . . . N. E. Mgr. Under-Feed Stoker Co. . . . . 430 Board of Trade Building, Boston, Mass. . . . Apr. 23, 1903.

George C. Tewksbury . N. E. Mgr. The Under-Feed Stoker Co. of America . . . . . 429-430 Board of Trade Bldg., 131 State St., Boston, Mass. . Apr. 24, 1902.

James T. Thornton . . Treas. Thornton Machinery Co. . . Providence, R. I. . . . Oct. 18, 1900.

William V. Threlfall . . Agt. Saco and Pettee Machine Shops, Biddeford, Me. . . . Apr. 24, 1895.

Rienzi W. Thurston . Machinery Manufacturer . . . . . Fall River, Mass. . . Oct. 18, 1900.

H. A. Tillinghast, . . . Treas. The Textile Finishing Mach. Co. . . . . Providence, R. I. . . . Apr. 25, 1901.

A. Curtis Tingley . . . Treas. National Ring Traveler Co. . . . . 257 West Exchange St., Providence, R. I. . . Sept. 22, 1896.
Allison W. Trafford . . Mfr. of Ring Travelers . . . . . 116 Pocasset St., Fall River, Mass. . . . Apr. 26, 1900.

Frank H. Underwood . Resident Mgr. Dodge Mfg. Co. . . . . 137 Purchase St., Boston, Mass. . . . Apr. 29, 1896.

Clement A. Wakefield . Selling Agt. Saco & Pettee Machine Shops, ... Biddeford, Me. . . . Apr. 25, 1901.
Justin A. Ware . . . . . Spring Hill, Barnstable County, Mass. Oct. 25, 1895.
J. F. Warren . . . . . Treas. J. F. & W. H. Warren Co. . . . . 44 Vine St., Worcester, Mass. . . Apr. 24, 1902.
Lettice R. Washburn . Mill Contractor, 235 North Water St., New Bedford, Mass. . Oct. 5, 1899.
George H. Watson . Pres. The Northern Engineering Co. . . . . 95 Liberty St., New York, N. Y. . . Apr. 23, 1903.
Walter S. Watson . . . Haworth & Watson, Mfrs. Paper Tubes for Textile Manufg. . . . . Box 996, Lowell, Mass. . . . Oct. 25, 1895.
Robert C. Webster . . Mgr. Barber & Colman . . . . . 11 Pemberton Sq., Rooms 1111-12, Boston, Mass. . . . Apr. 24, 1902.
Stephen M. Weld, . . Stephen M. Weld & Co., 89 State St., Boston, Mass. . . . Apr. 27, 1899.
William R. West . . . Roll Coverer . . 830 Purchase St., New Bedford, Mass. . Sept. 22, 1896.
W. W. White . . . . Agent Holyoke Machine Co. . . . Worcester, Mass. . . Apr. 27, 1899.
G. Marston Whitin . . Treas. Whitin Machine Works . . . Whitinsville, Mass. . Apr. 24, 1895.
Fred A. Wilde . . . . Gen. Mgr. The A. T. Atherton Machine Co. . . . . Prairie Ave., Pawtucket, R. I. . . Apr. 28, 1897.
Erving Yale Woolley . Stoddard, Haserick, Richards & Co. . . . . 152 Congress St., Boston, Mass. . . . . Apr. 24, 1895.

Honorary Members	3
Active Members	551
Associate Members	152
Total Membership	706

MEMBERS OF THE ASSOCIATION,

May 1, 1903.

ARRANGED BY STATES.

MAINE.

Auburn	William Hayes	Barker Mill.
Biddeford	H. P. Garland	Loom Picker Co.
Biddeford	Robert McArthur	Pepperell Mfg. Co.
Biddeford	William V. Threlfall	Saco & Pettee Machine Shops.
Biddeford	Clement A. Wakefield	Saco & Pettee Machine Shops.
Brunswick	Russell W. Eaton	Cabot Manufg. Co.
Kennebunk	Robert W. Lord	R. W. Lord & Co.
Lewiston	George W. Bean	Androscoggin Mills.
Lewiston	H. B. Estes	Continental Mills.
Lewiston	William D. Pennell	Hill Manufg. Co.
Lewiston	Herbert L. Pratt	Bates Manufg. Co.
Lisbon	Nathaniel F. Ayer	Farwell Mills.
Lewiston	James A. Walsh	Lewiston Bleachery and Dye Works
Lisbon	W. H. Miles	
Portland	Lyman M. Cousens	Dana Warp Mills.
Saco	James G. Garland	
Saco	Elmer E. Page	York Manufg. Co.
Sanford	Louis B. Goodall	Goodall Worsted Co.
Westbrook	Philip Dana	Dana Warp Mills.
Westbrook	Woodbury K. Dana	Dana Warp Mills.

NEW HAMPSHIRE.

Charlestown	Samuel Webber	Hydraulic Engineer.
Claremont	Frank P. Vogl	Monadnock Mills.
Dover	Charles H. Fish	Cocheco Manufg. Co.
Dover	George A. Hurd	76 Broadway.
Dover	Herbert W. Owen	Cocheco Manufg. Co.

Exeter	George E. Kent	Exeter Manufg. Co.
Exeter	Hervey Kent	Exeter Manufg. Co.
Greenville	Frederick W. Ely	Columbian Manufg. Co.
Hooksett	Stephen N. Bourne	Dundee Mills.
Manchester	Henry Deane Bourne	Hooksett Manufg. Co.
Manchester	D. D. Felton	S. A. Felton & Son Co.
Manchester	Alfred K. Hobbs	Rubber, Leather and Mill Supplies.
Manchester	Elliott Cowdin Lambert	Amoskeag Manufg. Co.
Manchester	Charles H. Manning	Amoskeag Manufg. Co.
Manchester	John K. Russell	476 Hall St.
Manchester	Herman F. Straw	Amoskeag Manufg. Co.
Manchester	George F. Whitten	Amory Manufg. Co.
Manchester	John H. Whitten	Stark Mills.
Milford	M. F. Foster	
Nashua	William F. Arthur	Nashua Manufacturing Co.
Nashua	William H. Cadwell	Jackson Co.
Nashua	Roscoe S. Milliken	Nashua Mfg. Co.
Newmarket	John L. Burton	Newmarket Mfg. Co.
Penacook	Marcellus Gould	N. H. Spinning Mills.
Penacook	F. E. Wattles	Boscawen Mills.
Peterboro	Albert W. Noone	Jos. Noone's Son's Co.
Salmon Falls	O. S. Brown	Salmon Falls Manufg. Co.
Somersworth	Charles H. Plummer	Great Falls Manufg. Co.
Suncook	David L. Jewell	China, Webster & Pembroke Mills.
Suncook	Edmund E. Truesdell	China, Webster & Pembroke Mills.

VERMONT.

North Pownal	Thomas Armstrong	North Pownal Manufg. Co.

MASSACHUSETTS.

Adams	John S. Adams, Jr.	Adams Bros. Manufg. Co.
Adams	Z. D. Hall	Berkshire Cotton Manufg. Co.
Adams	Emil Kipper	Renfrew Mfg. Co. and Windsor Print Works.
Adams	Charles T. Plunkett	Berkshire Cotton Manufg. Co.
Adams	L. B. Renfrew	Renfrew Mfg. Co.
Amesbury	M. W. Quinn	Hamilton Woolen Co.
Andover	John W. Bell	Smith & Dove Manufg. Co.
Belmont	John Kilburn	
Blackstone	George E. Spofford	Blackstone Manufg. Co.
Bondsville	Elmer G. Childs	Boston Duck Co.
Bondsville	Samuel Stewart	Boston Duck Co.
Boston	Charles B. Amory	Hamilton Mfg. Co.
Boston	Frederic Amory	Nashua Mfg.Co. and Jackson Mfg.Co.
Boston	Eugene C. Andres	517 John Hancock Builindg.

Boston	Edward Atkinson	Boston Mfrs. Mut. Fire Ins. Co.
Boston	E. W. Atkinson	Stoddard, Haserick, Richards & Co.
Boston	Edwin Barnes	Wm. Firth Co.
Boston	Albert Farewell Bemis	Jackson Fibre Co.
Boston	Frank P. Bennett	Am. Wool and Cotton Reporter.
Boston	Edward H. Best	Woolen Merchant.
Boston	F. H. Bishop	Universal Winding Co.
Boston	Arthur T. Bradlee	Harding, Whitman & Co.
Boston	J. Payson Bradley	The Kehew-Bradley Co.
Boston	S. Parker Bremer	Monadnock Mills.
Boston	Henry Gordon Brinckerhoff	Green Fuel Economizer Co.
Boston	John H. Burghardt	Page Belting Co.
Boston	Frank B. Comins	American Moistening Co.
Boston	Alphonse S. Covel	Tremont and Suffolk Mills.
Boston	Augustus De Cort	Beacon Mfg. Co.
Boston	P. Y. DeNormandie	Pepperell Mfg. Co.
Boston	John O. DeWolf	W. B. Smith Whaley & Co.
Boston	C. E. W. Dow	150 Devonshire St.
Boston	Frederic C. Dumaine	Amory Mfg. Co.
Boston	William Dresser Edwards	Buffalo Forge Co.
Boston	William Firth	Am. Moist. Co. and Wm. Firth Co.
Boston	Alfred M. Goodale	Boston Mfg. Co.
Boston	Arthur F. Gray	53 State St., Room 509.
Boston	Edwin Farnham Greene	Lockwood, Greene & Co.
Boston	Richard H. Hill	Jas. Hunter Machine Co.
Boston	William H. Hill	Windsor Co. and Renfrew Mfg. Co.
Boston	Franklin W. Hobbs	Arlington Mills.
Boston	John Hogg	Smith, Hogg & Gardiner.
Boston	Henry S. Howe	Dry Goods Commission.
Boston	Lemuel R. Howe	Howe, Fuller & Trunkett.
Boston	Charles W. Hubbard	Ludlow Mfg. Associates.
Boston	Joseph B. Jamieson	New England Cotton Yarn Co.
Boston	William B. Kehew	The Kehew-Bradley Co.
Boston	Evan Arthur Leigh	70 Kilby St.
Boston	William C. Lovering	Whittenton Mfg. Co.
Boston	Stephen C. Lowe	John Hetherington & Sons, Ltd.
Boston	A. Lawrence Lowell	53 State St.
Boston	Herbert Lyman	39 Beacon St.
Boston	Francis E. Macomber	21 Pearl St.
Boston	Charles T. Main	Dean & Main.
Boston	Fay H. Martin	Textile Machinery Co.
Boston	Fred C. McDuffie	Everett Mills and York Mfg. Co.
Boston	H. G. McKerrow	31 State St.
Boston	Charles B. Moore	Knowles Steam Pump Works.
Boston	George B. Morison	Ballou Yarn Co.
Boston	Robert W. Neff	Chemical Mfr.
Boston	William R. Noone	102 South St.

Boston	Sidney B. Paine	General Electric Co.
Boston	Benjamin Phipps	4 Winthrop Sq.
Boston	Henry Smith Pritchett, LL.D.	Mass. Institute of Technology.
Boston	Charles F. Randall	350 Tremont Building.
Boston	Charles E. Riley	C. E. Riley & Co.
Boston	C. E. Roberts	Hartford Steam Boiler Insp. & Ins.Co.
Boston	Arnold B. Sanford	Kennebec Spinning Mills.
Boston	J. Herbert Sawyer	93 Federal St.
Boston	George H. Shapley	Silver Lake Co.
Boston	J. A. Shepherd	The Stirling Co.
Boston	William F. Sherman	27 State St.
Boston	Elwood E. Taylor	Under-Feed Stoker Co.
Boston	George C. Tewksbury	The Under-Feed Stoker Co. of America.
Boston	James P. Tolman	Samson Cordage Works.
Boston	Edward B. Townsend	Warwick Mills.
Boston	Frank H. Underwood	Dodge Mfg. Co.
Boston	Robert C. Webster	Barber & Colman.
Boston	Stephen M. Weld	89 State St.
Boston	William Whitman	Arlington Mills.
Boston	Eben C. Willey	85 Pembroke St.
Boston	Franklin D. Williams	Fiskdale Mills.
Boston	Erving Yale Woolley	Stoddard Haserick, Richards & Co.
Cambridgeport	James H. Kendall	Edward Kendall & Sons.
Canton	Willis S. Shepard	Amer. Net & Twine Co.
Chicopee Falls	G. H. T. Babbitt	Chicopee Mfg. Co.
Clinton	William G. McLoon	Lancaster Mills.
Clinton	Charles H. Richardson	Lancaster Mills.
Clinton	John R. Rostron	Lancaster Mills.
Clinton	George P. Taylor	Danielsonville Cotton Co.
East Dedham	Benjamin M. Earl	Merchant Dye Works.
Easthampton	George A. Ayer	West Boylston Co.
East Hampton	William B. Fittz	
Fall River	F. S. Akin	Cornell Mills.
Fall River	Henry Ashworth	Agt. for Card Clothing Manufr.
Fall River	John P. Bodge	Arkwright Mills.
Fall River	Jefferson Borden, Jr.	Fall River Bleachery Co.
Fall River	Nathaniel B. Borden	Barnard Manufg. Co.
Fall River	Richard B. Borden	Richard Borden Mfg. Co.
Fall River	Isaac A. Brown	Narragansett Mills.
Fall River	George A. Chace	Bourne Mills.
Fall River	Simeon B. Chase	King Philip Mills.
Fall River	John A. Collins	American Linen Co.
Fall River	Bradford D. Davol	Barnard Manufg. Co.
Fall River	Frank H. Dwelly	Tecumseh Mills.
Fall River	David H. Dyer	D. H. Dyer & Son.

Fall River	John H. Estes	Cotton Manufacturer.
Fall River	William Evans	Wampanoag Mills.
Fall River	Charles F. Farrar	22 Coggeshall St.
Fall River	John T. Fyans	Fyans, Frazer & Blackway Co.
Fall River	Arthur M. Hamilton	Hargraves and Parker Mills.
Fall River	John F. Hamlet	P. O. Box 160
Fall River	Alfred H. Hartley	Oils and Mill Supplies.
Fall River	Samuel E. Hathaway	Fall River Iron Works Co.
Fall River	William Hathaway	Barnard Mfg. Co.
Fall River	William B. Hawes	Yarn Broker.
Fall River	George H. Hills	Davol Mills and Stevens Mfg. Co.
Fall River	William P. Holt	Barnaby Mills.
Fall River	George H. Law	Merchants' Mfg. Co.
Fall River	Samuel D. Lawton	Fall River Machine Co.
Fall River	Leontine Lincoln	Seaconnet Mills.
Fall River	Arthur H. Mason	Barnaby Mfg. Co.
Fall River	Philip A. Mathewson	King Philip Mills.
Fall River	Thomas McAuliffe	Stevens Manufg. Co.
Fall River	James A. McLane	Davis Mills.
Fall River	J. Edward Osborn	American Linen Co.
Fall River	Joseph H. Potter, Jr.	Durfee Mills.
Fall River	John Bion Richards	Davis Mills.
Fall River	Benj. H. Roberts	163 Grove St.
Fall River	Charles M. Shove	Granite Mills.
Fall River	Abbott E. Slade	Laurel Lake Mills.
Fall River	J. C. Smith	Chace Mills.
Fall River	John Sullivan	Union Cotton Manufg. Co.
Fall River	Timothy Sullivan	Stafford Mills.
Fall River	Richard Thackeray	Weetamoe Mills.
Fall River	Rienzi W. Thurston	Machinery Manufacturer.
Fall River	Horace W. Tinkham	Robeson Mills.
Fall River	M. J. Toohey	Mfr. Rope, Twine and Banding.
Fall River	Allison W. Trafford	Mfr. Ring Travelers.
Fall River	Robinson Walmsley	Tecumseh Mills.
Fall River	Joseph Watters	Osborn Mills.
Fisherville	Albert W. Dimick	Fisher Mfg. Co.
Fisherville	Charles W. Fisher	Fisher Mfg. Co.
Fiskdale	John Gregson	Fiskdale Mills.
Fitchburg	Ernest L. Hersom	Nockege Mill.
Fitchburg	George P. Grant, Jr.	Grant Yarn Co.
Fitchburg	W. E. Keach	Grant Yarn Co.
Fitchburg	John Leiper	Fitchburg Worsted Mills.
Fitchburg	Arthur H. Lowe	Parkhill Manufg Co.
Fitchburg	David Lowe	Parkhill Manufg. Co.
Fitchburg	Thomas C. Sheldon	Fitchburg Duck Mills.
Fitchburg	Walter F. Stiles	Orswell Mills.
Fitchburg	Ralph E. Thomson	Parkhill Manufg. Co., Mill C.

Great Barrington	Jno. H. C. Church	Monument Mills.
Holyoke	Samuel M. Green	The American Thread Co.
Holyoke	Ernest Lovering	Lyman Mills.
Hopedale	Eben S. Draper	Draper Co.
Hopedale	George A. Draper	Draper Co.
Hopedale	George Otis Draper	Draper Co.
Hopedale	William F. Draper	Draper Co.
Hopedale	William F. Draper, Jr.	Draper Co.
Hopedale	Frank J. Dutcher	Draper Co.
Housatonic	Theodore Ellis Ramsdell	Monument Mills.
Hyde Park	Calvin H. Lee	Readville Cotton Mills.
Indian Orchard	William C. Godfrey	Indian Orchard Co.
Indian Orchard	Henry C. Spence	Metallic Drawing Roll Co.
Indian Orchard	James Strang	Metallic Drawing Roll Co.
Ipswich	James W. Brown	Box 312.
Lawrence	William A. Barrell	Lawrence Duck Co.
Lawrence	Albert W. Brainard	Box 33.
Lawrence	Eugene E. Burnham	252 Lowell St.
Lawrence	G. B. Emmons	Emmons Loom Harness Co.
Lawrence	William D. Hartshorne	Arlington Mills.
Lawrence	Walter M. Hastings	Arlington Mills.
Lawrence	James I. Milliken	Everett Mills.
Lawrence	Walter E. Parker	Pacific Mills.
Lawrence	Robert Redford	Box 28.
Lawrence	Francis H. Silsbee	Pacific Mills.
Lawrence	Walter H. Summersby	Atlantic Cotton Mills.
Lawrence	William D. Twiss	Everett Mills.
Lawrence	William S. Whitney	American Woolen Co.
Leicester	Charles A. Denny	
Linwood	Amos G. Maddox	Linwood Mill.
Linwood	Fred B. Whitin	
Lowell	George E. Ames	Lawrence Manufg. Co.
Lowell	Frank A. Bowen	Appleton Co.
Lowell	Edward N. Burke	Lowell Machine Shop.
Lowell	W. W. Carey	Wood Rim Pulleys and Wood Working Machinery.
Lowell	Clarence N. Childs	Hamilton Mfg. Co.
Lowell	Daniel Clark	16 Fifth Ave.
Lowell	John J. Connell	Tremont and Suffolk Mills.
Lowell	A. G. Cumnock	Appleton Co.
Lowell	Joseph L. Cushing	Daniel Cushing & Co.
Lowell	Albert W. Danforth	Shanghai Cotton Cloth Mills.
Lowell	Albert Deabill	Lowell Hosiery Co.
Lowell	Edward P. Dennis	Lowell Machine Shop.
Lowell	William Ambrose Eastman	Hooper Knitting Co.
Lowell	Royal W. Gates	Josiah Gates & Sons.
Lowell	William E. Hall	Shaw Stocking Co.

Lowell	Charles C. Hedrick	Lowell Machine Shop.
Lowell	Otis L. Humphrey	Cotton Dept. Lowell Textile School.
Lowell	A. W. Hunking,	374 Stevens St.
Lowell	Frank B. Kenney	T. C. Entwistle Co.
Lowell	Charles F. Libby	Shaw Stocking Co.
Lowell	Alvin S. Lyon	Bigelow Co.
Lowell	Albert H. Morton	Kitson Machine Co.
Lowell	Oliver H. Moulton	Hamilton Manufg. Co.
Lowell	Will Nelson	Lowell Textile School.
Lowell	Franklin Nourse	Lawrence Manufg. Co.
Lowell	John W. Pead	Merrimack Manufg. Co.
Lowell	Haven C. Perham	Kitson Machine Co.
Lowell	M. A. Rawlinson	Tremont & Suffolk Mills.
Lowell	Edwin A. Robinson	Tremont and Suffolk Mills.
Lowell	William S. Southworth	Mass. Cotton Mills.
Lowell	Earl A. Thissell	Lowell Hosiery Co.
Lowell	Ariel C. Thomas	Boott Cotton Mills.
Lowell	Charles T. Upton	63 Mt. Vernon St.
Lowell	Jude C. Wadleigh	Mass. Cotton Mills.
Lowell	Frederick T. Walsh	Thomas Leyland & Co.
Lowell	Walter S. Watson	Haworth & Watson.
Lowell	Channing Whitaker	Lowell Machine Shop.
Lowell	Elias S. Willis	Boott Cotton Mills.
Lynn	John H. Nelson	Wm. Firth Co.
Lynn	Henry B. Sprague	Boston Woven Hose and Rubber Co
Lynn	C. J. H. Woodbury	61 Commercial St.
Manchang	T. B. Stevenson	Manchang Co.
Methuen	Lewis E. Barnes	Pemberton Co. and Methuen Co.
Methuen	Alfred Sagar	Arlington Cotton Mills.
Millbury	Fred W. Moore	Cordis Mills.
Millbury	Francis H. Rice	Holbrook Mfg. Co.
Millbury	Henry M. Wilcox	John Rhodes Warp Co.
Millis	W. Marshall Taylor	National Flax Fibre Co.
New Bedford	Christopher P. Brooks	New Bedford Textile School.
New Bedford	Richard Cowell	290 Summer St.
New Bedford	William W. Crapo	Wamsutta Mills.
New Bedford	Frederick Grinnell	Gen. Fire Extinguisher Co.
New Bedford	Henry A. Holcomb	Box 249.
New Bedford	Nathaniel B. Kerr	Butler Mill.
New Bedford	Walter H. Langshaw	Dartmouth Manufg. Corp.
New Bedford	Frederick B. Macy	Soule Mills.
New Bedford	John McCullough	Cotton Waste Merchant.
New Bedford	John Neild	Grinnell Mfg. Corp.
New Bedford	Albert R. Pierce	Pierce Mfg. Corp.
New Bedford	Andrew G. Pierce, Jr.	Pierce Mfg. Corp.
New Bedford	Frederick W. Reynolds	Potomska Mills.
New Bedford	James O. Thompson, Jr.	Wamsutta Mills.

New Bedford	Herbert E. Walmsley	Wamsutta Mills.
New Bedford	Lettice R. Washburn	235 North Water St.
New Bedford	William R. West	830 Purchase St.
New Bedford	Benjamin Wilcox	City and Bristol Mfg. Co.
New Bedford	Theop. W. Wilmarth	N. E. Cotton Yarn Co.
Newburyport	O. D. Drew	Peabody Mfg. Co.
New Bedford	Samuel F. Winsper	City Mfg Co.
Newton	Henry B. Ashton	S. A. Felton & Son Co.
Newton	Josiah G. Coburn	99 Washington St.
Newtonville	Oscar B. Truesdell	18 Washington Terrace.
Newton Upper Falls	Edmund E. Blake	Saco & Pettee Machine Shops.
Newton Upper Falls	Frank J. Hale	Saco and Pettee Machine Shops.
Newton Upper Falls	R. Paul Snelling	Saco and Pettee Machine Shops.
North Adams	Hervey Burnham	Beaver Mills and Eclipse Mill.
North Adams	Charles W. Dennett	Johnson-Dunbar Mills Co.
North Adams	Henry C. Phillips	Greylock Mills.
Northbridge	Henry S. Houghton, Jr.	Paul Whitin Manufg. Co.
Northbridge	Henry T. Whitin	Paul Whitin Manufg. Co.
North Cambridge	Collin C. Bell	American Vulcanized Fibre Co.
North Oxford	Edwin N. Bartlett	Sigourney and Rockdale Mills.
North Plymouth	Gideon F. Holmes	Plymouth Cordage Co.
Readville	George W. Stafford	George W. Stafford Co.
Readville	H. E. Stafford	George W. Stafford Co.
Salem	C. F. Curwen	Dinsmore Mfg. Co.
Salem	William P. McMullan	Naumkeag Steam Cotton Co.
Salem	Henry Osgood	P. O. Box 204.
Salem	Nathaniel G. Simonds	Naumkeag Steam Cotton Co.
Shattuckville	Frank S. Field	Massaemit Yarn Mills.
Somerville	Albert Birch	Somerville Machine Works.
Springfield	Joseph M. Dunham	43 Edwards St.
Springfield	Nelson Whittier	Whittier Mills.
Spring Hill	Justin A. Ware	
Taunton	A. C. Bent	Safety Seamless Pocket Co.
Taunton	William H. Bent	Mason Machine Works.
Taunton	Peter H. Corr	Greenwich Bleachery.
Taunton	Thomas G. Cox	Mason Machine Works.
Taunton	H. H. Culver	Elizabeth Poole Mills.
Taunton	Henry S. Culver	Westville Cotton Mills.
Taunton	Andrew J. Currier	New England Cotton Yarn Co.
Taunton	Herbert Fisher	
Taunton	Jesse A. Knight	Cohannet Mills.
Taunton	Henry M. Lovering	Whittenton Manufg. Co.
Taunton	William M. Lovering	Whittenton Manufg. Co.
Taunton	Charles L. Macomber	Winthrop Cotton Yarn Co.
Taunton	John Tempest Meats	Mason Machine Works.
Taunton	Herbert H. Shumway	Corr Manufg. Co.

Taunton	James W. Taylor	Canoe River Mills.
Taunton	Joseph S. Tidd	Oakland Mills.
Taunton	Henry Williams	Canoe River Mill.
Thorndike	Charles H. Hobbs	Thorndike Co.
Three Rivers	Roscius C. Newell	Palmer Mill.
Turners Falls	Samuel L. Parker	Turners Falls Cotton Mills.
Waltham	Charles E. Getchell	Waltham Emery Wheel. Co
Waltham	Arthur H. Gulliver	Boston Mfg. Co.
Ware	George E. Tucker	The Otis Co.
Webster	E. P. Morton	Stevens Linen Works.
Webster	William J. Stewart	H. N. Slater Mills.
West Warren	George A. Moody	West Warren Cotton Mills.
Whitinsville	Alfred E. Adams	Whitinsville Cotton Mills and Linwood Mills.
Whitinsville	Melvin H. Coffin	Whitin Machine Works.
Whitinsville	Lawrence M. Keeler	Whitin Machine Works.
Whitinsville	Josiah M. Lasell	Whitin Machine Works.
Whitinsville	Oscar L. Owen	Whitin Machine Works.
Whitinsville	Cyrus A. Taft	Whitin Machine Works.
Whitinsville	Arthur F. Whitin	Saunders Cotton Mills.
Whitinsville	G. Marston Whitin	Whitin Machine Works.
Whitinsville	James Earle Whitin	Uxbridge Cotton Mills.
Williamstown Sta.	Roland R. Kelly	Williamstown Manufg. Co.
Winchester	George H. Sayward	
Worcester	Joseph P. Battles	Crompton & Knowles Loom Works.
Worcester	George L. Brownell	Inventor and Builder of Improved Twisting Machinery Station A.
Worcester	Henry F. Harris	W. Boylston Mfg. Co.
Worcester	Lewis T. Houghton	997 Main St.
Worcester	A. H. Howard	Howard Bros. Mfg. Co.
Worcester	C. H. Hutchins	Crompton & Knowles Loom Works.
Worcester	Geo. E. Prest	
Worcester	Harry B. Prest	
Worcester	John E. Prest	
Worcester	Geo. I. Rockwood	62 Summer St.
Worcester	John M. Russell	Crompton & Knowles Loom Works.
Worcester	J. F. Warren	J. F. & W. H. Warren Co.
Worcester	W. W. White	Holyoke Machine Co.
Worcester	Alfred N. Whiting	L. M. Harris Mfg. Co.

RHODE ISLAND.

Allenton	R. A. Gray	Rodman Manufg. Co.
Ashton	Charles H. Collins	Berkeley Co.
Ashton	Robert Stewart	Ashton Mill.
Bayside	Abel T. Atherton	Machine Maker.

Central Falls	Louis B. Barker	United States Cotton Co.
Central Falls	David Grove	United States Cotton Co.
Central Falls,	B. F. G. Linnell,	Yarns, Threads and Twines.
Centreville	James T. Ferguson	Warwick Mills.
Centreville	Robert B. Treat	Centreville Cotton Mills.
Crompton	Charles D. Robinson	Crompton Co.
Davisville	Walter B. Knight	Reynolds Manufg. Co.
Fiskville	James Gee	Interlaken Dye Works.
Forestdale	Alphonso F. White	Forestdale Mfg. Co.
Georgiaville	A. E. Bosworth	Bernon Mills.
Lonsdale	Edward A. Mongeon	Lonsdale Mills.
Manville	A. Tenny White	Manville Co.
Natick	Charles M. Holmes	Natick Mills.
Pawtucket	V. T. Barber	Slater Cotton Co.
Pawtucket	William Washington Blades,	Lorraine Mfg. Co.
Pawtucket	Robert Burgess	Slater Cotton Co.
Pawtucket	William P. Dempsey	Dempsey Bleachery & Dye Works.
Pawtucket	Henry C. Dexter	Greene & Daniels Mfg. Co.
Pawtucket	Fred W. Easton	Easton & Burnham Machine Co.
Pawtucket	D. A. Everly	Cotton Mfr.
Pawtucket	David Jackson	Jackson Pat. Shell Roll Co.
Pawtucket	J. E. Jenckes	The E. Jenckes Manufg. Co.
Pawtucket	James R. MacColl	Lorraine Manufg. Co.
Pawtucket	E. R. Richardson	Howard & Bullough American Machine Co., Ltd.
Pawtucket	Dwight Seabury	12 East Ave.
Pawtucket	S. Willard Thayer	Dexter Yarn Co.
Pawtucket	Fred A. Wilde	A. T. Atherton Machine Co.
Peace Dale	William C. Greene	Peace Dale Manufg. Co.
Phenix	Henry R. Brown	Phenix Mill.
Pontiac	Walter B. Hall	Pontiac Mill, B. B. and R. Knight.
Providence	Charles T. Aldrich	Aldrich Manufg. Co.
Providence	William Ames	Fletcher Mfg. Co.
Providence	George R. Babbitt	American Oil Co.
Providence	Edward R. Ballou	Ballou Yarn Co.
Providence	Truman Beckwith	Dyerville Manufg. Co.
Providence	J. Frank Braids	Charles S. Bush Co.
Providence	H. Martin Brown	U. S. Bobbin & Shuttle Co.
Providence	E. C. Bucklin	Interlaken Mills.
Providence	Harris H. Bucklin	Interlaken Mills.
Providence	Fred N. Bushnell	Rhode Island Co.
Providence	Albert L. Calder, 2nd	P. O. Box 206.
Providence	Charles H. Child	Standard Mill Supply Co.
Providence	Frederick I. Dana	The Textile Machinery Finishing Co.
Providence	A. Lockwood Danielson	Quinebaug Co.
Providence	J. DeForest Danielson	Lockwood Co. and Lewiston Bleachery and Dye Works.

Providence	John W. Danielson	Lockwood Co. and Ponemah Mills.
Providence	F. C. Fletcher	Lawton Spinning Co.
Providence	J. Herbert Foster	10 South Water St.
Providence	Arthur C. Freeman	17 Exchange Pl.
Providence	William Gammell	Berkeley Co.
Providence	Rufus B. Goff	Standard Mill Supply Co.
Providence	Henry T. Grant	Mercantile Mutual Fire Insurance Co.
Providence	John H. Hambly	Quidnick Mfg. Co.
Providence	A. Walter Harris	A. W. Harris Oil Co.
Providence	Elisha H. Howard	Cotton Goods Broker.
Providence	Frederic W. Howe	Crompton & Knowles Loom Works.
Providence	Daniel Jackson	B. B. & R. Knight.
Providence	Albert F. Knight	Box 835.
Providence	John E. Kendrick	American Supply Co.
Providence	Stephen A. Knight	Hebron Manufg. Co.
Providence	Webster Knight	B. B. & R. Knight's Mills.
Providence	W. C. Langford	86 Weybosset St.
Providence	J. Colby Lewis	23 Ralph St.
Providence	Charles Warren Lippitt	Silver Spring B. & D. Co.
Providence	Henry F. Lippitt	Social and Manville Cos.
Providence	Charles R. Makepeace	Box 973.
Providence	F. H. Maynard	Gen. Fire Extinguisher Co.
Providence	Thomas Mayor	Thomas Mayor & Son.
Providence	Charles H. Merriman, Jr.	Manville Co.
Providence	William C. Peirce	Elizabeth Mills.
Providence	Reuben Pilling, Jr.	30 Hudson St.
Providence	Stephen Minot Pitman	Narragansett Mutual Fire Ins. Co.
Providence	Charles A. M. Praray	Chas. A. M. Praray & Co.
Providence	Richard H. Rice	Providence Engineering Works.
Providence	George W. Robbins	Dyerville Mfg. Co.
Providence	Louis E. Robinson	36 So. Water St.
Providence	Richard W. B. Sanderson	G. S. Lings & Co.
Providence	Frank P. Sheldon	Industrial Trust Building.
Providence	Harry M. Smith	Standard Mill Supply Co.
Providence	Wilton H. Spencer	7 Exchange Place.
Providence	Daniel J. Sully	T. M. Reynolds & Co.
Providence	Robert Rennie Taft	P. O. Box 1443.
Providence	Robert W. Taft	Coventry Co.
Providence	Charles F. Taylor	Burgess Cop Tube Co.
Providence	D. M. Thompson	B. B. & R. Knight's Mills.
Providence	James T. Thornton	Thornton Machinery Co.
Providence	H. A. Tillinghast	The Textile Finishing Machinery Co.
Providence	A. Curtis Tingley	National Ring Traveler Co.
Providence	W. O. Todd	Lawton Spinning Co.
Providence	William P. Vaughan	Putnam Mfg. Co.
Riverpoint	Arthur F. Brackett	Royal Arctic and Valley Queen Mills.
Valley Falls	Edward B. Jennings	Samoset Co.

Valley Falls	John W. Ramsbottom	Samoset Co.
Warren	Arnold Schaer	Warren Manufg. Co.
Westerly	Robert Dow	Solway Mills.
Westerly	A. E. Henry	Solway Mills.
Westerly	Robert B. Meikle	Lorraine Mfg. Co.
Wickford	Joseph Warren Greene	
Woonsocket	Malcolm Campbell	Woonsocket Mach. & Press Co.
Woonsocket	Harry K. Drew	Clinton Mfg. Co.
Woonsocket	William Halliwell	Providence and Woonsocket Mills of the Lawton Spinning Co.
Woonsocket	W. G. Hartford	Hamlet Textile Co.
Woonsocket	Edward W. Houghton	Globe Mill, Manville Co.
Woonsocket	Henry S. Houghton, Sr.	61 Pond St.
Woonsocket	Albert C. Hoy	
Woonsocket	William N. Kimball	Social and Nourse Mills.
Woonsocket	Frederick Ott	Hamlet Textile Co.
Woonsocket	William A. Robinson	Manville Co.
Woonsocket	Charles E. Thomas	Forestdale Mfg. Co.

CONNECTICUT.

Baltic	Harold Lawton	Baltic Mills Co.
Danielson	Gordon A. Johnstone	Danielson Cotton Co.
Danielson	Henry D. Martin	Danielson Cotton Mfg. Co.
Danielson	James Herbert Smith	Quinebaug Co.
Hartford	William H. Stratton	Factory Insurance Association.
Jewett City	Frederick D. Ballou	W. A. Slater Mills.
Jewett City	James O. Sweet	Ashland Cotton Co.
Jewett City	Adelbert R. Young	Ashland Cotton Co.
Killingly	H. C. Atwood	Williamsville Manufg. Co.
Killingly	W. E. Atwood	Williamsville Manufg. Co.
Killingly	C. H. Truesdell	Attawaugan Co.
Middletown	Joseph Merriam	Springfield Webbing Co.
Middletown	J. F. Powers	Spinning Mill.
Montville	Emory S. Rathbun	Pequot Mills.
Moosup	William J. Cray	Aldrich Mfg. Co.
New Haven	George S. Barnum	The Bigelow Co.
New London	Louis L. Hohn	Cor. Conn. Ave. and McDonald St.
Norwich	W. N. Blackstone	Attawaugan Co. and Totokett Mills Co.
Norwich	W. R. Burnham	
Norwich	C. H. Frisbie	Attawaugan Co.
Norwich	W. G. Henderson	Falls Co.
Norwich	Charles D. White	Uncasville Manufg. Co.
Norwich	Wm. I. Woodward	Shetucket Co.
Putnam	George W. Holt	Monohansett Manufg. Co.

Putnam	George A. Vaughan	Putnam Manufg. Co.
Taftville	Joseph D. Aiken	Ponemah Mills.
Taftville	John Eccles	Ponemah Mills.
Uncasville	Robert G. McMeehan	Uncasville Mfg. Co.
Versailles	John H. Holt	Totokett Mills Co.
Voluntown	George T. Briggs	The Briggs Mfg. Co.
Wauregan	James A. Atwood	Wauregan Co. & Quinebaug Co.
Wauregan	John Walter Atwood	Wauregan Co.
Willimantic	Peter Hardman	American Thread Co., Willimantic Mills.
Willimantic	Dickerson G. Baker	American Thread Co.
Willimantic	E. S. Boss	American Thread Co.
Willimantic	Joseph Mercer	Willimantic Cotton Mills Co.
Windsor Locks	J. R. Montgomery	The J. R. Montgomery Co.

NEW YORK.

Brooklyn	Hugh De Haven	De Haven Mfg Co.
Capron	W. H. Cloher, Jr.	Utica Cotton Co.
Chadwicks	Bradford C. Divine	Utica Willowvale Bleaching Co.
Cohoes	David S. Johnston	Harmony Mills.
Cohoes	William H. Robinson	No. 3 Harmony Mill.
Elmira	William H. Bilbrough	Elmira Knitting Mills and Conewawah Spinning Co.
Jamestown	Thomes Henry Smith	Jamestown Cotton Mill.
Newburgh	William J. Hadfield	Newburgh Steam Mills.
New York City	George Arms	Grand Hotel.
New York City	Edwin H. Baker	Bliss, Fabyan & Co.
New York City	D. C. Ball	5 Beekman St.
New York City	Percy H. Brundage	49 Wall St.
New York City	French Campbell	James Freeman Brown Co.
New York City	Albert C. Case	25 Broad St. Room 1213.
New York City	J. E. Cheesman	Cheesman Cotton Gin Co.
New York City	C. C. Cowan	27 William St.
New York City	Charles Henry Davis	25 Broad St.
New York City	L. L. Flemming	American Cotton Co.
New York City	Ernest L. Hill	Renfrew Mfg. Co.
New York City	Arthur B. Mann	J. H. Martin & Co.
New York City	Arthur Parkinson	Arabol Mfg. Co.
New York City	Duncan D. Parmly	Johnson Mfg. Co. & Dunbar Mills Co.
New York City	Vladimir P. Polevoy	Jaroslav Cotton Mill.
New York City	Theodore H. Price	Cotton Dealer.
New York City	William N. Shaw	The Lincoln Iron Works & Jackson Architectural Iron Works.
New York City	George A. Wies	Eureka Fire Hose Co.
New York City	George H. Watson	The Northern Engineering Co.

New York Mills, Oneida Co., John P. Campbell, New York Mills.
Syracuse . . . . . Sanford E. Loring . . . . 341 Delaware St.
Upper Troy . . . . A. G. Harris . . . . . 10 Third St.
Utica . . . . . George DeForest . . . . Utica Steam and Mohawk Valley Cotton Mills.
Utica . . . . . George E. Farrell . . . . Utica Spinning Co.
Utica . . . . . D. W. Gray . . . . . Skenandoa Cotton Co.
Utica . . . . . Henry F. Mansfield . . . Utica Steam Cotton Mills and Mohawk Valley Cotton Mills.
Utica . . . . . Pardon B. Sanford . . . . Utica Spinning Co.
Utica . . . . . Albion K. Searls . . . . Oneita Knitting Mills.
Utica . . . . . John B. Wild . . . . . Oneita Knitting Mills.

NEW JERSEY.

East Newark . . . Halsey Connett . . . . . Clark Mile End Spool Cotton Co.
Gloucester City . . Philip H. Fowler . . . . 417 Monmouth St.
Gloucester . . . . George W. Turner . . . . Argo Mills Co.
Jersey City . . . . Ernest Bridge . . . . . Jas. Chadwick & Bro. Ltd.
Jersey City . . . . Maxwell Grierson . . . . Jas. Chadwick & Bro., Ltd.
Jersey City . . . . B. L. Stowe . . . . . Eureka Fire Hose Co.
Millville . . . . . C. Enos Bean . . . . . Millville Mfg. Co.
Millville . . . . . John F. Reardon . . . . Millville Mfg. Co.
Newark . . . . . William H. Loftus . . . . Clark Thread Co.
New Brunswick . . William Henry Hobbs . . Johnson & Johnson Co.
New Brunswick . . William H. Ritter . . . . Johnson & Johnson.
Passaic . . . . . E. W. Davenport . . . . Brighton Mills.
Passaic . . . . . Dudley T. Lyall . . . . . Brighton Mills.
Passaic . . . . . William L. Lyall . . . . Brighton Mills.
Paterson . . . . . John W. Ferguson . . . . Paterson Nat. Bank Bldg.

PENNSYLVANIA.

Chester . . . . . W. T. Galey . . . . . Aberfoyle Manufg. Co.
Chester . . . . . D. Edwin Irving . . . . The Irving & Leiper Manufg. Co.
Chester . . . . . D. Irving Trainer . . . . Agt. Lincoln Mfg. Co.
Lancaster . . . . Henry G. McCarter . . . John Farnum & Co. Conestoga Mills 2 & 3.
Mt. Joy . . . . . Thomas J. Brown . . . . George Brown's Sons.
Philadelphia . . . Robert Beatty . . . . . Robt. Beatty & Co.
Philadelphia . . . T. Ashby Blythe . . . . . Ashby Cotton Mills.
Philadelphia . . . Alfred H. Burnham . . . Glasgow Mills.
Philadelphia . . . Harry W. Butterworth . . H. W. Butterworth & Sons.
Philadelphia . . . James Butterworth . . . H. W. Butterworth & Sons.
Philadelphia . . . Byron F. Card . . . . . 300 Chestnut St.
Philadelphia . . . Frederick A. Downes . . Factory Mutual Fire Insurance Cos.
Philadelphia . . . Edward W. France . . . Philadelphia Textile School.

Phildelphia	Simon Friedberger	Friedberger Mfg. Co.
Philadelphia	Merrill A. Furbush	2015 North 33rd St.
Philadelphia	Otto Goetze	Glasgow Mills.
Philadelphia	John T. Greenwood	R. Greenwood & Bault.
Philadelphia	Henry S. Grove	Argo Mills Co.
Philadelphia	W. C. Houston	Hope Mills Mfg. Co.
Philadelphia	John H. Lorimer	Ontario and Lawrence Sts.
Philadelphia	David Milne	Washington Ave and 10th & 11th Sts.
Philadelphia	John R. Mitchell	Mitchell-Bissell Co.
Philadelphia	Edward H. Sanborn	Cold Spring Bleach. & Fin. Works.
Philadelphia	William E. Winchester	Philadelphia Textile School.
Philadelphia	George Wood	Millville Mfg. Co.
Philadelphia	John P. Wood	521 N. 22nd St.
Philadelphia	Oscar W. Wood	Germantown Spinning Co.
Yardley	Theodore C. Search	Cold Spring Bleaching and Finishing Works.
Yardley	R. Irving Tobey	Cold Spring Bleaching and Finishing Works.

DELAWARE.

Wilmington	William P. Bancroft	Joseph Bancroft & Sons Co.
Wilmington	Daniel Moore Bates	Joseph Bancroft & Sons Co.

MARYLAND.

Baltimore	James A. Gary	Gary Mfg. Co.
Baltimore	Wm. E. Hooper	Woodberry Division of Mt. Vernon Woodberry Co.
Baltimore	Charles K. Oliver	Continental Bldg.
Ilchester	Samuel F. Patterson	Thistle Mills Co.

NORTH CAROLINA.

Asheville	William Whittam, Jr.	The William Whittam Textile Co.
Charlotte	S. B. Alexander, Jr.	S. B. Alexander, Jr. Co.
Charlotte	R. M. Miller, Jr.	Elizabeth Mills.
Charlotte	Edward W. Thomas	Buford Hotel.
Charlotte	Daniel A. Tompkins	D. A. Tompkins Co.
Durham	O. W. Stites	Elliott Fuel Saving Co.
Fayetteville	Walter L. Holt	Holt-Morgan Mills.
Greensboro	Caesar Cone	Proximity Mfg. Co.
Hope Mills	Frank H. Cotton	Hope Mills Mfg. Co.
Kings Mountain	F. Dilling	Dilling Cotton Mills.
Lincolnton	R. S. Reinhardt	Elm Grove Cotton Mills.
Mountain Island	W. T. Jordan	Mt. Island Manufg. Co.
Winston-Salem	John W. Fries	F. & H. Fries.

SOUTH CAROLINA.

Chester	William G. Nichols	Springstein Mills.
Columbia	Louis I. Guion	Columbia Mills Co.
Columbia	James Sumter Moore	Olympia & Richland Cotton Mills.
Columbia	W. H. Rose	Richland, Granby & Olympia Cotton Mills.
Columbia	W. B. Smith Whaley	Richland & Granby Cotton Mills.
Fort Mill	Farquharson J. Muir	Fort Mill Mfg. Co. & Millfort Mill Co.
Gaffney	H. D. Wheat	Gaffney Mfg. Co. and Orient Mfg. Co.
Graniteville	T. H. Rennie	Graniteville Mfg. Co.
Greenville	James B. Duggan	Union Bleaching and Finishing Co.
Lancaster	Leroy Springs	Lancaster Cotton Mills.
Langley	Arthur T. Smith	Langley Manufg. Co. and Aiken Manufg. Co.
Laurens	O. B. Parker	Laurens Cotton Mills.
Newberry	Edward B. Wilbur	Mollohon Mfg. Co.
Pelham	D. G. Sunderland	The Pelham Mills.
Pelzer	Ellison A. Smyth	Pelzer Manufg. Co.

GEORGIA.

Aragon	D. E. McGaw	Aragon Mills.
Atlanta	J. W. Bailey	The A. French Textile School.
Atlanta	Samuel A. Carter	Gate City Cotton Mills.
Atlanta	W. L. Draper	Dodge Mfg. Co.
Atlanta	Oscar Elsas	Fulton Bag and Cotton Mills.
Atlanta	Henry E. Fisher	Atlanta Cotton Mills.
Atlanta	Harry W. Kimball	Fulton Bag and Cotton Mills.
Atlanta	William M. Nixon	Atlanta Woolen Mills.
Atlanta	James R. Pearce	560 South Pryor St.
Augusta	Thomas Barrett, Jr.	Langley & Aiken Mills.
Augusta	John W. Chafee	The Sibley Mfg. Co.
Augusta	T. I. Hickman	Graniteville Mfg. Co.
Augusta	Otis G. Lynch	Enterprise Manufg. Co.
Augusta	Peleg A. Rhodes	Cotton Mill Mutual Fire Ins. Co.
Augusta	Joel Smith	J. P. King Mfg. Co.
Augusta	George R. Stearns	Riverside Mills.
Augusta	Eugene F. Verdery	Warren Mfg. Co.
Chattahoochee	W. R. B. Whittier	Whittier Mills.
Columbus	E. N. Clemence	Eagle & Phenix Mills.
Columbus	Frederick B. Gordon	Columbus Mfg. Co.
Columbus	Charles H. Gorton	Columbus Mfg. Co.
Columbus	Walter Rigby	Bibb Mfg. Co.
Columbus	George W. Towne	Columbus Power Co.
East Point	Edward C. Beach	Gate City Cotton Mills.

Griffin, Spalding Co.	Albert G. Martin	Kincaid Manufg. Co.
Harmony Grove	Charles M. Sears	Harmony Grove Cotton Mills.
Lawrenceville	Albert E. McDonald	Lawrenceville Mfg. Co.
Lindale	Henry P. Meikleham	Mass. Mills in Georgia.
Macon	W. H. Richmond	Bibb Mill No. 2.
Macon	Broadus E. Willingham	Willingham Cotton Mills.

TENNESSEE.

Knoxville	William T. Lang	Brookside Mills.
Memphis	Jerome Hill	Jerome Hill Cotton Co.

ILLINOIS.

Chicago	Frederick A. Flather	International Harvester Co., (McCormick Div.)

MISSISSIPPI.

Starkville	Arthur Whittam	John M. Stone Cotton Mills and Miss. Textile Schcol.

LOUISIANA.

New Orleans	S. Odenheimer	Lane Mills.

KENTUCKY.

Henderson	Paul J. Marrs	Henderson Cotton Mills.
Louisville	Philip S. Tuley	Louisville Cotton Mills Co.

ALABAMA.

Birmingham	B. B. Comer	Avondale Cotton Mills.
Birmingham	Joseph O. Hannum	1805 10th Ave. So.
Cordova	Scott Maxwell	Indian Head Mills of Ala.
Pell City	Arthur J. Draper	Pell City Mfg. Co.
Pell City	Edward T. Garsed	Pell City Mfg. Co.

COLORADO.

Denver	John L. Jerome	Overland Cotton Mill Co.

CANADA.

Province of Ontario.

Cornwall	S. Greenwood	The Canadian Colored Cotton Mills Co., Ltd.
Hamilton,	Charles Owen Dexter	The Candian Colored Cotton Mills Co., Ltd.

Hamilton,	James M. Young	Hamilton Cotton Co.
Ottawa	Louis Simpson	Victoria Chambers.

Province of Quebec.

Montreal	Alfred Hawkesworth	Merchants Cotton Co.
Montreal	Fred Hawkesworth	Merchants Cotton Co.
Montreal	D. K. McLaren	751 Craig St.
Montreal	A. B. Mole	Dominion Cotton Mills Co.
Valleyfield	Ernest E. Clark	Montreal Cotton Co.
Valleyfield	Fred Lacey	Montreal Cotton Co.
Valleyfield	Charles H. Potter	Montreal Cotton Co.

NEW BRUNSWICK.

Milltown	Lewis Dexter, Jr.	The Canadian Colored Cotton Mills Co., Ltd.
St. John	John B. Cudlip	Cornwall and York Cotton Mills Co.
St. John	John H. Parks	John H. Parks & Co.

ENGLAND.

Huddersfield	John Sykes	English Card Clothing Co.
Matlock, Derbyshire,	John Edward Lawton	American Thread Co.
Norfolk, London, W. C.,	William F. Parish, Jr.	Vacuum Oil Co. (Tech. Dept.)

RUSSIA.

Moscow	Vladimir Malinin	Prochoroff Three Hill Mfg. Co.

RECAPITULATION.

LOCATION OF MEMBERSHIP.

Maine	20
New Hampshire	30
Vermont	1
Massachusetts	329
Rhode Island	113
Connecticut	37
New York	37
New Jersey	15
Pennsylvania	29
Delaware	2
Maryland	4
North Carolina	13
South Carolina	15
Georgia	30
Tennessee	2
Illinois	1
Mississippi	1
Louisiana	1
Kentucky	2
Alabama	5
Colorado	1
Province of Ontario	4
Province of Quebec	7
New Brunswick	3
England	3
Russia	1
	706

IN MEMORIAM.

COL. THOMAS J. BORDEN.

Col. THOMAS J. BORDEN died at Providence, R. I., November 21, 1902. He was born at Fall River, Mass., March 1, 1832, and at 16 entered the employment of the Fall River Iron Works Company of which his father, Col. RICHARD BORDEN, was treasurer. After remaining one year, he entered the Lawrence Scientific School of Harvard University and completed the two years' course. Upon his return to Fall River in 1851 he resumed his connection with the Fall River Iron Works Company and in the summer of 1853, although but 21 years of age, he was appointed treasurer and agent of the Bay State Print Works. In February, 1860, he became agent and treasurer of the Troy Cotton and Woolen Manufactory, and in 1868 was chosen president and agent of the Mechanics Mills of Fall River, afterwards becoming treasurer. In 1871 he organized the Richard Borden Manufacturing Company, of which he became treasurer. He was later treasurer of the American Print Works of Fall River. In addition to these positions, he was on the board of directors of many corporations devoted to manufacturing, insurance, railroad, steamship lines and banks and was in this manner at one time connected with 36 different corporations.

He had a keen sense of the obligations of public duties upon citizens and was chief of the Fall River fire department, a mem-

ber of the city government and a member of the militia, in which, by successsive promotions, he became colonel in 1868. He was a member of the Central Congregational Church of Fall River, in whose affairs he took a deep interest, and was a member of the American Board of Commissioners for Foreign Missions. On February 20, 1855, he was married to Miss MARY E. HILL, who survives him with their three daughters. He was one of the charter members of this Association at its formation in April 20, 1865, in which he took a lively interest, being regular in attendance at the meetings. He made three contributions upon drawing rolls, one upon fuel and one upon warp spinning.

THOMAS C. ENTWISTLE.

THOMAS C. ENTWISTLE was born in England, Sept. 8, 1846, and died Jan. 7, 1903. He was a descendant of a family of mill managers who later turned attention to manufacturing mill machinery. He came to this country with the family when he was young and was first employed in setting up machinery at Manchester, N. H., and afterwards went to Lewiston, Me., where he constructed the first machine ever made in America for manufacturing expansion combs of warpers. In 1875 he left Lewiston for the service of the Hopedale Machine Company and went to Lowell in 1880 where he organized the Phœnix Machine Company, of which he became the agent. Some time after, he became agent of the Woodruff Iron Works at Hartford, Conn., and in 1887 returned to Lowell, where he engaged in manufacturing textile machinery.

He was a member of the First Universalist Church, the Masons, in which he had a high standing, and the Ancient and Honorable Artillery Company of Boston. In 1884 he married Miss AMANDA STEVENS, of Lowell, who survives him. He became a member of this Association April 24, 1895.

JOSHUA GARSED.

JOSHUA GARSED was born at Glen Riddle, Pa., August 1, 1834, and died April 6, 1903. In his boyhood he was apprenticed at the shops of William Sellers & Co., Philadelphia, and when free, entered the manufacturing business at the Aramingo Mills, Frankford, and later was in partnership with JOHN T. STONE at the Willow Brook Mills. In August, 1862, he became lieutenant in the Union Army, in which he made a record as a brave and skillful officer. After the war he entered into the manufacturing business at the Wingohocking Mills with his brother, the late RICHARD GARSED, ex-president of this Association, and was in active connection with the mills at the time of his death. He was an inventor of considerable note, some of his inventions being highly profitable to him. He was a member of the Manufacturers' Club of Philadelphia, of the Masons and of the Grand Army of the Republic. He became a member of this Association Oct. 21, 1897. He married Miss ANNIE WILLIAMS in 1866 by whom he had two children and is survived by his son, Mr. WALTER R. GARSED, with whom he was associated in business.

THEODORE G. RAMSDELL.

THEODORE G. RAMSDELL died at Albany, N. Y., March 1, 1903. He was born at Milford, N. H., Feb. 8. 1833, and early went into the cotton mill of the Columbian Manufacturing Company at Greenville, N. H., and thence to the Nashua Manufacturing Company. When he was 16 years old, he became overseer of a spinning mill at the New Souhegan Mill. Three years later he attended the Appleton Academy at Mount Vernon, and resuming his connection with manufacturing, he became em-

ployed in cotton mills at Nashua, Holyoke, Manchester, and Indian Orchard, until October, 1864, when he became superintendent of the Monument Mills, Housatonic, Mass., and after 22 years became agent of the company. Mr. RAMSDELL was a progressive man in the adoption of new machinery and methods. He married MISS MARY B. SPENCER, June 12, 1873, and is survived by her and two sons and two daughters. He became a member of this Association, October 30, 1878.

HON. FREDERIC CLARK SAYLES.

HON. FREDERIC CLARK SAYLES was born in Pawtucket, R. I., July 17, 1835, being a descendent of ROGER WILLIAMS by the lineage of both parents, and died Jan. 5, 1903. In his eighteenth year he entered his brother's bleachery at Saylesville, in which he became a partner, in these works, which he expanded to become the largest of their kind in the world. He was also interested in numerous other mills and dye works. He had a thorough knowledge of the details of manufacturing and spared no pains in making the work produced by his establishment first class in every respect. When Pawtucket became a city in 1886, he was elected its first mayor and re-elected for a second term. The duties of his position made such an encroachment upon the time required for his business affairs that he declined renomination.

He was once a major in the militia and was connected as an officer or director of numerous manufacturing, street railway, and banking corporations. He gave to Pawtucket a memorial library. He is survived by two sons and two daughters. He became a member of this Association Oct. 28, 1897.

PROCEEDINGS.

In accordance with the legal notice, the stated annual meeting of the Association was held in Chipman Hall, Boston, Mass., April 22nd and 23rd, 1903. The following 235 members and 94 guests were present.

ACTIVE MEMBERS.

ALFRED E. ADAMS, Whitinsville, Mass.
JOSEPH D. AIKEN, Taftville, Conn.
THOMAS ARMSTRONG, No. Pownal, Vt.
EDWARD ATKINSON, Boston, Mass.
E. W. ATKINSON, Boston, Mass.
H. C. ATWOOD, Killingly, Conn.
NATHANIEL F. AYER, Lisbon, Me.
EDWARD R. BALLOU, Providence, R. I.
LOUIS B. BARKER, Central Falls, R. I.
V. T. BARBER, Central Falls, R. I.
LEWIS E. BARNES, Methuen, Mass.
EDWIN N. BARTLETT, North Oxford, Mass.
DANIEL MOORE BATES, Wilmington, Del.
JOSEPH P. BATTLES, Worcester, Mass.
ROBERT BEATTY, Philedelphia, Pa.
WM. WASHINGTON BLADES, Pawtucket, R. I.
RICHARD B. BORDEN, Fall River, Mass.
A. E. BOSWORTH, Georgiaville, R. I.
STEPHEN N. BOURNE, Manchester, N. H.
FRANK A. BOWEN, Lowell, Mass.
A. W. BRAINERD, Lawrence, Mass.
CHRISTOPHER P. BROOKS, New Bedford, Mass.

ROBERT BURGESS, Pawtucket, R. I.
EDWARD N. BURKE, Lowell, Mass.
HERVEY BURNHAM, North Adams, Mass.
JOHN L. BURTON, Newmarket, N. H.
BYRON F. CARD, Philadelphia, Pa.
DANIEL CLARK, Lowell, Mass.
JOSIAH G. COBURN, Newton, Mass.
CHARLES H. COLLINS, Ashton, R. I.
JOHN A. COLLINS, Fall River, Mass.
FRANK B. COMINS, Boston, Mass.
JOHN J. CONNELL, Lowell Mass.
WILLIAM J. CRAY, Moosup, Conn.
P. T. CREED, Taunton, Mass.
PHILIP DANA, Westbrook, Me.
ALBERT DEABILL, Lowell, Mass.
CHARLES W. DENNETT, North Adams, Mass.
EDWARD P. DENNIS, Lowell, Mass.
CHARLES A. DENNY, Leicester, Mass.
HENRY C. DEXTER, Pawtucket, R. I.
ALBERT W. DIMICK, Fisherville, Mass.
BRADFORD C. DIVINE, Chadwicks, N. Y.
GEORGE OTIS DRAPER, Hopedale, Mass.
WILLIAM F. DRAPER, Hopedale, Mass.
HARRY K. DREW, Woonsocket, R. I.
O. D. DREW, Newburyport, Mass.
FRANK J. DUTCHER, Hopedale, Mass.
RUSSELL W. EATON, Brunswick, Me.
FREDERICK W. ELY, Greenville, N. H.
JAMES T. FERGUSON, Centreville, R. I.
CHARLES H. FISH, Dover, N. H.
CHARLES W. FISHER, Fisherville, Mass.
F. C. FLETCHER, Providence, R. I.
M. F. FOSTER, Milford, N. H.
ARTHUR C. FREEMAN, Providence, R. I.
JOHN W. FRIES, Winston-Salem, N. C.
CHARLES E. GETCHELL, Waltham, Mass.
GEORGE P. GRANT, Jr., Fitchburg, Mass.
D. W. GRAY, Utica, N. Y.

R. A. GRAY, Allenton, R. I.
JOHN GREGSON, Fiskdale, Mass.
DAVID GROVE, Central Falls, R. I.
ARTHUR H. GULLIVER, Waltham, Mass.
FRANK J. HALE, Newton Upper Falls, Mass.
WALTER B. HALL, Pontiac, R. I.
WILLIAM E. HALL, Lowell, Mass.
Z. D. HALL, Adams, Mass.
WILLIAM HALLIWELL, Woonsocket, R. I.
JOHN F. HAMLET, Fall River, Mass.
HENRY F. HARRIS, Worcester, Mass.
WILLIAM D. HARTSHORNE, Lawrence, Mass.
ALFRED HAWKESWORTH, Montreal, P. Q.
FRED HAWKESWORTH, Montreal, P. Q.
WILLIAM HAYES, Auburn, Me.
ERNEST L. HERSOM, Fitchburg, Mass.
FRANKLIN W. HOBBS, Boston, Mass.
CHARLES M. HOLMES, Natick, R. I.
GEORGE W. HOLT, Putnam, Conn.
JOHN H. HOLT, Versailles, Conn.
HENRY S. HOUGHTON, Jr., Northbridge, Mass.
OTIS L. HUMPHREY, Lowell, Mass.
JOHN H. HOLT, Versailles, Conn.
JOSEPH B. JAMIESON, Boston, Mass.
DAVID S. JOHNSTON, Cohoes, N. Y.
W. E. KEACH, Fitchburg, Mass.
ROLAND R. KELLY, Williamstown Station, Mass.
NATHANIEL B. KERR, New Bedford, Mass.
JOHN KILBURN, Belmont, Mass.
STEPHEN A. KNIGHT, Providence, R. I.
HAROLD LAWTON, Baltic, Conn.
EVAN ARTHUR LEIGH, Boston, Mass.
JOHN LEIPER, Fitchburg, Mass.
CHARLES F. LIBBY, Lowell, Mass.
ARTHUR H. LOWE, Fitchburg, Mass.
WILLIAM L. LYALL, Passaic, N. J.
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FREDERICK B. MACY, New Bedford, Mass.

CHARLES R. MAKEPEACE, Providence, R. I.
CHARLES H. MANNING, Manchester, N. H.
HENRY F. MANSFIELD, Utica, N. Y.
THOMAS MAYOR, Providence, R. I.
ROBERT MCARTHUR, Biddeford, Me.
WILLIAM G. MCLOON, Clinton, Mass.
JOHN TEMPEST MEATS, Taunton, Mass.
JOSEPH MERCER, Willimantic, Conn.
JOSEPH MERRIAM, Middletown, Conn.
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J. R. MONTGOMERY, Windsor Locks, Conn.
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GEORGE B. MORISON, Boston, Mass.
ALBERT H. MORTON, Lowell, Mass.
JOHN NEILD, New Bedford, Mass.
ALBERT W. NOONE, Peterboro, N. H.
HERBERT W. OWEN, Dover, N. H.
WALTER E. PARKER, Lawrence, Mass.
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HERBERT L. PRATT, Lewiston, Mass.
M. W. QUINN, Amesbury, Mass.
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BENJAMIN H. ROBERTS, Fall River, Mass.
EDWIN A. ROBINSON, Lowell, Mass.
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J. C. SMITH, Fall River, Mass.

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F. E. WATTLES, Penacook, N. H.
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ARTHUR F. WHITIN, Whitinsville, Mass.
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GEORGE F. WHITTEN, Manchester, N. H.
JOHN H. WHITTEN, Manchester, N. H.
HENRY M. WILCOX, Millbury, Mass.
JOHN B. WILD, Utica, N. Y.
THEOP. W. WILMARTH, New Bedford, Mass.
C. J. H. WOODBURY, Lynn, Mass.
WILLIAM I. WOODWARD, Norwich, Conn.

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HENRY ASHWORTH, Fall River, Mass.

EDWIN BARNES, Boston, Mass.
ALBERT BIRCH, Somerville, Mass.
F. H. BISHOP, Boston, Mass.
EDMUND E. BLAKE, Newton Upper Falls, Mass.
ARTHUR T. BRADLEE, Boston, Mass.
J. FRANK BRAIDS, Providence, R. I.
HENRY GORDON BRINCKERHOFF, Boston, Mass.
H. MARTIN BROWN, Providence, R. I.
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WALTER MAXWELL HASTINGS, Lawrence. Mass.
CHARLES C. HEDRICK, Lowell, Mass.
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DAVID JACKSON, Pawtucket, R. I.
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FRANCIS E. MACOMBER, Boston, Mass.
FAY H. MARTIN, Boston, Mass.
ROBERT W. NEFF, Boston, Mass.
JOHN H. NELSON, Boston, Mass.

WILLIAM R. NOONE, Boston, Mass.
SIDNEY B. PAINE, Boston, Mass.
ARTHUR PARKINSON, New York, N. Y.
STEPHEN MINOT PITMAN, Providence, R. I.
CHARLES A. M. PRARAY, Providence, R. I.
PELEG A. RHODES, Augusta, Ga.
DWIGHT SEABURY, Pawtucket, R. I.
HARRY M. SMITH, Providence, R. I.
GEORGE W. STAFFORD, Readville, Mass.
H. E. STAFFORD, Readville, Mass.
CHARLES F. TAYLOR, Providence, R. I.
GEORGE C. TEWKSBURY, Boston, Mass.
WILLIAM V. THRELFALL, Biddeford, Me.
A. CURTIS TINGLEY, Providence, R. I.
ALLISON W. TRAFFORD, Fall River, Mass.
FRANK H. UNDERWOOD, Boston, Mass.
CLEMENT A. WAKEFIELD, Biddeford, Me.
JUSTIN A. WARE, Spring Hill, Mass.
GEORGE H. WATSON, New York, N. Y.
WALTER S. WATSON, Lowell, Mass.
ROBERT C. WEBSTER, Boston, Mass.
W. W. WHITE, Worcester, Mass.
FRED A. WILDE, Pawtucket, R. I.
ERVING YALE WOOLLEY, Boston, Mass.,

GUESTS.

I. ABRAHAMS.
W. A. ANTIO.
A. A. ASPINWALL.
W. W. BALLAGH.
C. H. BARCLAY.
I. W. BARR.
L. A. BARRETT.
WILLIAM BODDEN.
WILLIAM T. BONNER.
EDWARD A. BRIGHAM.
J. A. BROCK.
M. D. BROWN.
C. B. BURLEIGH.
FRANK H. BURT.
A. C. BUTTER.
W. A. CONGDON.
L. W. CAMPBELL.
F. O. CARPENTER.
ALBERT A. CARY.
A. H. CHAMBERLAIN.
F. E. CHANDLER.
J. H. CHASE.
J. A. COOPER.
W. P. COTHARIN.
ROBERT R. CRAWFORD.
J. H. CROSSLEY.

H. C. Daggett.
S. S. Dale.
M. A. Darcy.
Walter J. Denny.
F. M. Dillan.
Harry P. Dodge.
M. K. Dunham.
H. C. Eccles.
Howard Emerson.
C. H. Fair.
L. C. Farnsworth.
Henry Fisher.
H. T. Frasier.
George Fuller.
P. Gillam.
M. E. Gleason.
G. H. Grogan.
Charles L. Hall.
H. I. Harriman.
J. F. Harvey.
A. M. Hersom.
A. E. Howes.
G. E. P. U. Huckaby.
Samuel L. Johnston.
I. J. O. Keefe.
E. L. Kelley.
Joseph C. King.
Henry G. Kittredge.
John Lamson.
Philip C. Leon.
H. G. Lord.
R. M. Mackay.
E. L. Martin.
John W. Mayor.
James H. McKinley.
C. J. McPherson.
J. S. Merchant
E. L. Merrow.
M. A. Metcalf.
James C. Miller.
Fred C. Morrison.
Charles M. Mumfort.
Frank L. Nagle.
W. C. Nairn.
F. G. Page.
J. B. Palmer.
F. B. Perry.
G. C. Petty.
George E. Pickering.
A. F. Ray.
H. C. Reynold.
R. L. Reynolds.
Charles H. Russell.
Geo. H. Sherman.
Charles T. Slack.
L. B. Smith.
O. W. Smith.
William Spencer.
L. J. Steinmetz.
Jacob Stephens.
W. I. Stimpson.
Henry P. Thompson.
M. C. Tuttle.
Edward N. Vose
H. J. Webber.
Wm. Welch.
P. C. Wentworth.
A. J. Wurts.

FIRST SESSION.

CHIPMAN HALL, BOSTON, MASS.
WEDNESDAY, April 22, 1903,

The meeting was called to order at 11 A. M., President CHARLES H. FISH in the chair.

The PRESIDENT. If you please come to order, gentlemen. the Secretary will read the call for the meeting.

The Secretary read the following call for the meeting:

BOSTON, MASS., April 1, 1903.

To the Members:

Notice is hereby given that the stated Annual Meeting of this Association will be held at Boston, Mass., Wednesday and Thursday, April 22 and 23, 1903.

In accordance with the notice given at the 73rd meeting, an amendment will be submitted in accordance with Article 15 of the Constitution and By-Laws, viz.:

Article 1, after line 3, insert the words in italics, so that the sentence shall read, "Shall be eligible for active membership *in the American Cotton Manufacturers' Association.*"

In accordance with the Constitution and By-laws, the above will require the assent of two-thirds of the members present and voting thereon for its adoption.

If the sentiment of the members is favorable to this change, then the Board of Government will submit, in accordance with the Revised Laws of Massachusetts, Chapter 109, Section 9, the following proposition:

1. Shall the name of this Association be changed to the
AMERICAN COTTON MANUFACTURERS' ASSOCIATION,
provided authority be obtained for the change from the Commissioner of Corporations of the Commonwealth of Massachusetts?

2. Will this Association instruct its President and Secretary to apply in its behalf to the Commissioner of Corporations for authority to make the above change of its corporate name?

Two-thirds of the members present and voting thereon must vote in the affirmative in order to adopt the foregoing proposals.

The sessions will be held in Chipman Hall, in the Tremont Temple, No. 88 Tremont Street, a short distance south of School Street, and opposite the Tremont Building. The entrance is at No. 88 Tremont Street, and Chipman Hall is on the sixth floor, reached by elevators.

The sessions will be called to order on Wednesday at 11 A. M., and 2 P. M., and on Thursday at 10 A. M., and 2 P. M.

By order of the Board of Government,

C. J. H. WOODBURY,

Secretary.

It is expected that His Honor, Gen. CURTIS GUILD, Jr., Lieutenant Governor of the Commonwealth of Massachusetts, will greet the members with a welcome at the opening session.

The Board of Government especially hope that at this meeting the various papers will receive a full discussion and that inability to attend the meeting may not be considered by any one an impediment, as discussions may be written and sent to the Secretary to be read. For the purpose of furnishing better facilities for a discussion, the papers are to be printed in advance, if the manuscripts are received in time by the Secretary, and copies of such papers will be sent on request to any member five days before the meeting.

The full programme will not be issued until the meeting, but papers are expected on the following subjects:

An English Textile School.
Committe on Fire Tests of Cotton Bales.
Continued Development of the Northrop Loom.
Current Theories of Dyeing.
Smoke and the Determination of its Density.

Gray Goods for White Lawn Work.
Improved Ginning Methods.
Improving the Cotton Fibre.
Local Transportation in Mill Economics.
Louisiana Purchase Exposition.
Regulation of Water Wheels.
Supply of Cotton for Fine Spinning.
Steam Trap.
Stop Motions for Engines.
Textile Education.
Use of Reheaters in Compound Engines.

And other papers of which the exact titles have not been received.

The souvenir badges will be given to those members who are in attendance, and the Board of Government has given instructions that duplicates shall not be given until after the adjournment, but other souvenir badges will be given to the guests of members.

It is desired that applications for membership shall be received as far as possible in advance of the meeting.

A blank proposition for membership is enclosed for convenience in submitting the names of any who would be desirable members. Many persons have not become members because they have not been invited. Candidates for membership will receive the same privileges as the members. Blank propositions are also inside the front cover of the Transactions, or will be sent on application.

Members who have overlooked their postal card receipts for Transactions are requested to give the matter attention, as it is only through this means that the headquarters of the Association are able to know that members receive the volumes and notices to which they are entitled, and to keep an accurate record for sending Transactions and notices to members.

It is important that the Association should be promptly informed of changes of address of any members.

In reply to a request on the subject, the Board of Government has directed the Treasurer to accept $100 in full payment of dues by an active member, awaiting further action of the Association, and notice of an amendment to the Constitution and By-laws, providing for life membership on this basis, will be given at the forthcoming meeting.

The SECRETARY. Mr. President, I certify that in accordance with article 14 of the constitution and by-laws, a copy of this notice was mailed to each member ten days at least in advance of this meeting and that a quorum is now present.

The programme for the meeting was as follows:

PROGRAMME.

First Session, Wednesday, April 22, 1903, at 11 A. M.

Call to Order.

Election of Officers.

Welcome to the Association.
HIS HONOR, GEN. CURTIS GUILD, JR., Lieutenant-Governor of the Commonwealth of Massachusetts.

President's Address.
CHARLES H. FISH, Dover, N. H.

Award of the Association Medal.
NATHANIEL B. KERR, Chairman of Special Committee.

Reports of the Secretary and Treasurer.

Business.

The Supply of Cotton for Fine Spinning.
HENRY G. KITTREDGE, Boston, Mass.

Continued Development of the Northrop Loom.
GEN. WILLIAM F. DRAPER, Hopedale, Mass.

Second Session, Wednesday, April 22, 1903, at 2 P. M.

Local Transportation in Mill Economics.
CLARENCE J. MESSER, Boston, Mass.
(Illustrated by the Stereopticon.)

Improving the Cotton Fibre.
DR. H. J. WEBBER, WASHINGTON, D. C.
(Illustrated by the Stereopticon.)

Improved Ginning.
CHARLES J. MCPHERSON, South Framingham, Mass.

Current Theories of Dyeing.
JOHN W. FRIES, Winston-Salem, N. C.

Gray Goods for White Lawn Work.
DANIEL MOORE BATES, Wilmington. Del.

Report of Committe on Fire Tests of Cotton Bales.
EDWARD W. THOMAS, Charlotte, N. C.
WILLIAM D. HARTSHORNE, Lawrence, Mass.

Third Session, Thursday, April 23, 1903, at 10 A. M.

Textile Education.
WALTER MAXWELL HASTINGS, Lawrence, Mass.

An English Textile School.
T. M. YOUNG, Manchester, England.

The Use of Reheaters in Compound Engines.
GEORGE H. BARRUS, Boston, Mass.

Stop Motion for Engines.
THOMAS HENRY SMITH, Jamestown, N. Y.

Steam Trap.
THOMAS HENRY SMITH, Jamestown, N. Y.

Smoke and the Determination of Its Density.
ALBERT A. CARY, 95 Liberty St., New York, N. Y.

Fourth Session, Thursday, April 23, 1903, at 2 P. M.

Election of Members.

Export Markets for American Cotton Goods.
EDWARD N. VOSE, 290 Broadway, New York, N. Y.

Factory Tenements.
ARTHUR H. GULLIVER, Waltham, Mass.

Cotton and Cotton Goods at the Louisiana Purchase Exposition.
JONN H. MCGIBBONS, Eastern Representative,
23 West Thirty-fourth St., New York, N. Y.

Native Spindle Whorls of North America and Adjacent Territory.
H. NEWELL WARDLE, Academy of Natural Sciences,
Logan Square, Philadelphia, Pa.

Census of Cotton Spindles in the United States.
C. J. H. WOODBURY, Boston, Mass.

The souvenir badges will be given to those members who are in attendance, and the Board of Government has given instructions that duplicates shall not be given until after the adjournment, but other souvenir badges will be given to the guests of members.

A limited number of tickets, each admitting the bearer with friends, including ladies, to the Sixty-eighth Exhibition of Paintings at the Boston Art Club, corner of Dartmouth and Newbury Streets, open from 9 A. M. to 10 P. M., may be obtained of the Secretary.

The records of the last meeting were read by the Secretary and accepted.

ELECTION OF OFFICERS.

The PRESIDENT. The next business in order is the election of officers for the ensuing year. Has any one any suggestions to make ?

Mr. WALTER E. PARKER. Mr. President, I move that a committee of three be appointed by the chair to bring in nominations for officers for the ensuing year.

The motion was seconded and carried.

The PRESIDENT. As such committee I will appoint Messrs. WALTER E. PARKER, ARTHUR H. LOWE and EDWARD W. ATKINSON, and that committee will report tomorrow if it is agreeable.

The PRESIDENT. Gentlemen, in opening this convention it is my first duty and great pleasure to give this place to one who is so well known throughout America that to attempt a formal introduction in Boston, his own home, would be perhaps absurd. We are very fortunate in having with us this morning, His Honor, CURTIS GUILD, Jr., Lieutenant Governor of the Commonwealth of Massachusetts. [Applause.]

WELCOME ON THE BEHALF OF THE COMMONWEALTH OF MASSACHUSETTS.

LIEUTENANT GOVERNOR CURTIS GUILD, Jr. Mr. President and gentlemen of the Association, I thank you most heartily for the kind words you have said of me, sir, and you, gentlemen, for your kindly welcome. It was a great pleasure to come to you in this place a few years ago in the capacity of a commercial journalist. It is even a greater pleasure to come to you today and to bring you not merely the general greeting of the first cotton manufacturing State in the American Union, the Commonwealth of Massachusetts, but the hearty personal greeting of its Governor, JOHN L. BATES. [Applause.]

We have every reason to congratulate ourselves as New Englanders that in spite of competition New England holds the sceptre of cotton manufacture in this country, and as Americans that all over the world, notably in China and in Australia, thousands who a decade ago had never seen a yard of American cotton cloth are now proving its excellence by practical use.

I congratulate you that our exports of American cotton manufactures have risen from $9,999,277 in 1890 to $24,003,087 in 1900, and to $32,108,362 in 1902.

There is no condition so good, however, that it might not be better, and I cannot refrain from calling to your attention facts familiar to you which indicate one grave cause of unrest in this particular industry. The man who is really interested in his country or in the industries of his country does not confine himself to boasting and glorification, but shows his interest by calling attention to serious facts that are not sometimes so pleasant.

The number of active cotton spindles in the country, including those in woolen mills, in 1900, was 19,472,232, against 14,384,180 in 1890. It is pleasing for us to note that of these 19,472,232 active spindles 13,171,377 are in New England; and, if you will pardon a little State pride, that 7,932,883, nearly double the total (4,354,034) in all the Southern States put together, are in Massachusetts alone.

It is idle, however, to deny the fact that the rate of increase in the South is much swifter than in New England. In the decade covered by the last two takings of the census the active cotton spindles of New England have, indeed, leaped from 10,934,297 to 13,171,377, but those in the South have leaped from 1,563,598 to 4,354,034.

Of the Southern States containing cotton spindles in 1900 not one shows a loss. In fact all show a gain. This is not the case, you very well know, in all the New England States nor in all the Middle States. The South is not only gaining, but it is gaining in part at Northern expense, forcing us if not to reduce our force at least to change the character of our product.

Of brown and bleached shirtings and sheetings, for example, the South produced 644,577,686 square yards, against 481,298,187 in New England. South Carolina mills in 1900 reported cotton exports to the value of $6,994,651, against $3,489,240 for Massachusetts.

In 1900 the New England States employed in the cotton mills alone 162,294 wage earners, and paid them $55, 367,541. In the cotton mills alone there were 12,850,987 spindles, making the labor cost per spindle $4.31. The South in its cotton mills employed 97,494 persons, paid them $17,501,648 for operating 4,298,188 spindles, making the cost per spindle $4.07.

In other words, the South, in comparison with New England, pays five-eighths as many operatives a little over a third as much wages for operating about a third as many spindles.

If this condition were to be constant it might not cause apprehension, but while, taking a longer period, the labor cost per spindle has increased in New England in twenty years from $3.73 to $4.31 in spite of the constant improvements in machinery, the labor cost in the South, with the benefit of the same improvements, has decreased from $5.08 to $4.07.

Some explanation may be found in the fact that of the 40,258 children under sixteen years of age in the cotton mills of this country, only 11,048 are working with 12,891,787 spindles

in New England against 24,459 at 4,299,988 spindles in the Southern States.

In other words Southern competition does not merely mean the competition of adult labor rapidly becoming more skilful. It means also the competition of cheaply paid child labor. Not proximity to the cotton fields alone, not climate alone, but cheap labor, long hours, together with an utter absence or extreme moderation of taxation, explain the growth of the South.

There is the situation. It isn't altogether pleasant. This at least, however, should in honesty be said — the "poor white" child in the Southern cotton mill at least gets food and some education. The poor white in his native home got little of the first and none of the second. The condition of the children in the southern cotton mills is better than the condition of the children in the wild woods of North Carolina. The wages in Southern cotton mills are small according to our standard, but they are paid to people who, until the Southern cotton mills were started, never had a dollar of their own from one year's end to the other.

By the substitution of fine goods for coarse goods in our factories Massachusetts has managed to put off the day of settlement, even to show an increase in the number of our spindles, but ultimately the day of settlement must come and we must face and deal with conditions that have reduced the spindles in so many of our Northern States.

I am sure that none of us would wish Massachusetts to repeal any of the laws that have gained us the reputation of leading among the States in humane regulations of factory labor, but we cannot even with the best intentions march too far in advance of the procession, for the same lack of local restrictions on the age and hours of labor that makes Southern competition particularly severe in cotton manufacturing makes the competition of other States severe in other industries.

Of the New England States, Vermont is the least advanced in labor legislation. Children over ten years of age may be put in cotton mills in Vermont and made to labor ten hours a day.

Maine and New Hampshire restrict the age to 12 years and the working day to 10 hours. Connecticut restricts the age to 14 years and the day to 10 hours. Rhode Island cuts the hours to 58 a week, but leaves the age at 12 years. Massachusetts alone restricts the age to 14 years and the hours to 58 a week, a combination of the highest age and the shortest time restrictions in New England.

Set against this Southern conditions. What has been the custom may be guessed by what is called a reform law just passed in South Carolina, forbidding the employment of children *under ten years of age* after May 1, 1903. In Alabama a similar law is being considered. It has not yet been passed as far as cotton mills, but at least in the mines of Alabama children of less than ten years are at last forbidden to toil.

The four leading cotton manufacturing States of the South, far ahead of all the rest, are respectively South and North Carolina, Georgia and Alabama. In South Carolina children under 10 years are still employed. After next month the limit is set at 10 years. After May 1, 1904, the limit will be 11 years; after May 1, 1905, 12 years. These children may be worked 66 hours a week. In North Carolina the age limit is 12 years, but there is no legal limit whatever as to the hours that a child of that tender age may be worked. In Georgia there is no limit as to age and practically none as to time, the law permitting an infant if desired to be employed "from sunrise to sunset." In Alabama the law is yet to be passed prohibiting the employment of the labor of children under 10 years of age in cotton mills and there is no limit as to the hours of labor.

This is one of the very rare cases where self-interest and the common good of humanity point to the same path. The abolition of child labor throughout the country would, to be sure, make the pressure of competition less hard for manufacturers in States that have already abolished child labor. To deny that fact would be mere hyprocrisy. On the other hand surely the common good of humanity demands that nowhere in the United States, nor in any industry, should it be possible for an employer

to work a child of less than 10 or even of less than 14 years of age for a number of hours limited only by the caprice of the employer.

Massachusetts with the shortest time limit and the oldest age limit of any New England State has to face the competition of States that limit neither age nor time.

The solution of the problem is not in admitting little children to the Massachusetts mills nor in lengthening the hours of Massachusetts labor, but here and now to begin a crusade that the demands of humanity, enforced by law in Massachusetts, shall be enforced by law in all the States.

Let us not drag Massachusetts down to the level of Alabama, let us lift Alabama to the level of Massachusetts. [Applause.]

The South is not the only sinner in regard to child labor and Massachusetts has not always been a saint. It is encouraging to note that already both Alabama and South Carolina have started on the upward path for humanity's sake, even at the risk of business disadvantage. Tennessee already limits the age of factory labor to 14 years and the limitations as to age and hours in Virginia if not as strict as those in Massachusetts are at least as strong as those in Maine and New Hampshire. What we need is not a change in the South alone, nor in cotton factories alone, but uniform legislation covering the whole country and all industries.

The old order changes. There was a time when one law as to bankruptcy swayed New England and another Texas or Pennsylvania. We have lived to learn the disgrace of State divorce laws by which sin in Massachusetts is virtue in South Dakota, and the country is alive to the necessity of a national law regulating divorce.

Let us have uniformity of factory law throughout the United States.

It is idle for Massachusetts to stand alone with wise restrictions when other States compete with the toil of infant fingers against the labor of men and women.

I congratulate you that one of your own number, Mr. LOVER-

ING, has at least made the first move in Congress towards an amelioration of the conditions caused by forty-five separate systems of labor and factory laws in what is, or should be, one country.

It may not come by Constitutional amendment, it may come by a common agreement among the States, it may come merely as the result of an agreement among all, both employers and employees, engaged in the industry. It must come somehow, that artificial distinctions in cotton manufacturing, caused by State boundary lines, shall disappear and make way for restrictions that shall be uniform for the whole country.

If humanity does not move us to agitate for the freedom of little children from factory servitude wherever it exists today, self preservation may force us to do it tomorrow. [Applause.]

PRESIDENT'S ADDRESS.

CHARLES H. FISH, Dover, N. H.

Gentlemen of the New England Cotton Manufacturers' Association : As I again welcome you in convention, I feel that great pleasure and that touch of pride which only those who have been permitted to welcome a like body of men can understand and appreciate. It is perhaps with unusual pleasure and appreciation that I greet you today, which is not alone due our Association or its immediate connections, of which we can be justly proud, but an intense appreciation of our country with its glorious industrial and commercial interests, its magnificent natural advantages and its flood of American energy everywhere.

Since our last meeting, it has been my good fortune to be allowed again to visit the lands of our forefathers, with whom our industrial interests are now and will be in the years to come, in friendly rivalry. Following as I did to some extent the same course taken on a previous visit, I am in position to note certain unmistakable signs, showing without doubt that the phenomenal advancement or increase of American industrials during the past few years had been the means of arousing our foreign neighbors to a full appreciation of what they term their own industrial stagnation, and with a degree of energy perhaps to themselves unheard of, they are now bending to the oars in a pursuit which is sure to develop into a close and exciting industrial race as the time goes on.

You will note that I take the position that America is now well in the lead. In many respects, yes; in some respects, however, I believe not. England, Germany, France and Russia,

to say nothing of Japan and the other countries, are doing magnificent work, each in its own way, and the time will come, or in some cases is here, when each one of these countries will produce far more than its home consumption warrants, and then, like America, they will be seeking the outside markets for its surplus or overflow.

It certainly is to be the survival of the fittest, and whereas we are led to suppose that America with its vast resources and with its energy is in the future destined to become and to continue as the great industrial nation of the world, we must not overlook the fact, if I may be allowed a word of warning, that even with all her advantages, America cannot compete, either in cotton manufacturing or in any of her industrial branches, without a continuance of the same systematic and untiring energy which has made her famous the world over.

It often follows that success breeds contentment, and contentment is sometimes responsible for indifference, and indifference is sure to be sooner or later fatal to one's best interests.

I do not prophesy, nor do I believe, that America will lose her prestige through indifference, but we may lose at least a portion of it through over-confidence, resulting in failure to keep relative pace with our competitors in foreign countries.

A prominent English manufacturer is responsible for the statement that England is still able to defeat all competitors upon common ground; that with an abatement of our protective tariff, English products would find a ready market in America, and that at a profit to the English manufacturer. By the re-organizations or additions already begun, or about to be begun, she is at least sure of maintaining the markets of her own possessions and of the great Eastern Hemisphere. And, gentlemen, although I cannot say that I believe this statement in toto, I have sufficient respect for the ability of England, Germany and Russia, to say nothing of the other countries, to realize that there is some ground for this statement, so apparently broad.

The educational development in the foreign countries is re-

markable. Favorable laws have been enacted and everywhere we find a determined movement towards better education of the young men, along the lines which they are in after life to follow. The technical and textile schools are magnificent in their organization and equipment, although we must admit that in this respect America has in the last few years come rapidly into prominence. The whole trend of cotton manufacturing industry throughout, I may say the entire civilized world, is towards improvement in design, as well as in fabrics and in finishing, and at the same time what is more important, economies in the production, without which under the present conditions all improvements must become mere idealties. The source from which these future improvements are expected and must come, will be derived in a great measure from the work in the textile schools, by providing among the coming generations those who shall be better equipped than those of the present generation, in the making of fabrics under the more trying commercial conditions and where the measure of the usefulness is based as now upon the ability to operate a plant in such a manner that the invested capital shall not only be preserved but shall receive in addition adequate returns.

At the same time, we must remember that textile education works no miracles. The most that can be expected is to give in the student, concentrated form, the gleanings of experience from many fields. When a person works in a single mill, the technical portion of his knowledge is obtained from a small field and to this extent it has its limitations. The superiors or managers are ordinarily so pressed with the duties of their positions that even under the most advantageous conditions the amount of individual experience which they can impart is far less than that of teachers who are devoting their whole time to these purposes. Our foreign brothers were the first to attack the question understandingly. They have, after long years of experience, found that their industries were crippled for want of properly educated men in places of responsibility. They have established their schools, and in many cases the government is now controlling

their output, distributing their graduates where their services are most required. It seems to me eminently proper, and perhaps of the utmost importance, that our national government should maintain the technical and textile schools throughout the country, giving them financial aid and assistance sufficient to guarantee their maximum usefulness in the years to come. Many of our schools are already receiving substantial aid from the state governments. This may be sufficient in some cases, but I believe that for all, strong national backing is desirable.

Gentlemen, there is another question, which, to manufacturers, is the important question of the hour. If America is to maintain her position in the industrial world, some means must speedily be devised towards creating a more perfect understanding and accord between capital and labor. It is quite apparent that the country cannot continue indefinitely under the same conditions as now exist. We seem to be going through an everlasting evening-up process, which apparently does not even, but which resembles more a continuous flight of stairs leading downward into the pit of oblivion, but upward to where no one knows.

It is upon this flight that the conflict is now being waged. Labor, with commendable motives, is attempting to rise, and industry, representing capital, is, or certainly should be, not only willing, but anxious that it should, so long as the stepping-up process of labor does not by unreasonable demands or rushes, draw industry downward, or perchance force her off entirely. Victorious labor crowded at the top, with industry and capital abandoned and lying helpless in the pit, is a sorry picture for thoughtful labor to contemplate. Labor must rise and must be protected. Our best interests demand it, but at the same time, for the sake of our industries, the demands of labor should be reasonable. Cripple labor and you cripple industry; cripple the industry and you aim a death blow at everything. For our country's sake, no industry should be forced beyond reason. From unreasonable attempts on either side there should be protection.

It is, I think, a well known and acknowledged fact that the curse of England today is the attitude of its labor unions. Labor unions do not thrive in England, although they exist in power. A few Sundays ago I was in London and witnessed a parade of one department of organized labor in the city of London. For hours the line was passing the hotel. I wish that the clean and well dressed operatives of our mills could have witnessed this exhibition of shiftlessness and poverty. Carrying soiled and torn, and in many cases ragged, banners, and worn out transparencies, many with vicious sentiments, this detachment of the labor army of England straggled by. Some appeared intelligent and were well dressed, but of these there were so few that they were eclipsed by the stolid indifference of the great mass. I remarked to one of the many policemen who stood near that if the union was really of advantage to these men, what would they have been without the union. His reply was characteristic: "Every man is carrying a millstone. You can't see it, but it is there."

And so it goes; the curse of the labor unions is often their own existence. On general principles, the operative who can obtain fair treatment and a fair wage, must be better off as a free individual than as a member of a labor organization, with whom he may or may not be in accord. Let us hope that in America we may in some way soon find relief, relief both to labor and capital, on some common ground, satisfactory to both, bringing assurance of peace and good will and allowing our energies to be expended in the legitimate carrying on of our various occupations, rather than in wearing each other out in civil strife.

AWARD OF THE ASSOCIATION MEDAL.

The PRESIDENT. The next business in order is the award of the Association medal. Mr. NATHANIEL B. KERR and Mr. ARTHUR H. GULLIVER were the committee to award this medal, and we are now ready to learn their award.

The report of the committee was read by Mr. NATHANIEL B. KERR, as follows:

March 24, 1903.

To the Board of Government,

Gentlemen: The committee to whom the Board of Government referred the awarding of the Association medal for work done in 1902 looking toward the interests and purposes for which the Association was formed, submit the following:

While many of the papers read before the Association show a great deal of care and study in their preparation it seems to the Committee that the one presented on page 145 of Volume 73 of the Transactions* contains an amount of information that cannot be lightly passed over. It also shows that the author of this paper has a most intimate knowledge regarding a subject of peculiar interest to mill men and must have performed a great amount of careful and personal work to obtain such complete results.

Your Committee, therefore, take pleasure in awarding the Association medal for 1902, to WILLIAM D. HARTSHORNE of Lawrence, Mass.

Respectfully submitted,

N. B. KERR,
A. H. GULLIVER,
Committee.

The PRESIDENT. Mr. HARTSHORNE, it gives me very great pleasure to hand you the medal which has been awarded by the committee. [Applause.]

Mr. WILLIAM D. HARTSHORNE. Gentlemen, I am taken with extreme surprise. I had not the slightest idea of receiving

* "Observations on Spindle Banding. — A Plea for Something Better," by WILLIAM D. HARTSHORNE. (Transactions, Volume 73, page 145.)

this medal, and I only hope that the little information which I have given in that paper may be of some use to some one in extending it further. As intimated in that paper, the subject seemed to my mind as being far from well understood and as one about which there is much yet to be learned. The method of driving spindles therein represented is to my mind imperfect; some day I hope to be able to discover something far superior. I thank the Association and the gentlemen of the committee for their award. [Applause.]

The PRESIDENT. Next, gentlemen, is the reports of the Secretary and Treasurer.

THE SECRETARY'S REPORT.

During the past year the Association has maintained its position in matters pertaining to its purpose of improvements in the manufacture of cotton, and its two meetings have been favored with a wide range of contributions to the subject.

THE ASSOCIATION MEDAL.

During the past year there have been two Association medals awarded, one to CHARLES H. FISH, of Dover, N. H., for his contributions on the drying of textile fabrics as contained in the papers, The Possibilities of a New Method for Drying Textile Fabrics, Transactions, volume 65, page 226: The Practical Results Obtained in the Drying of Textile Fabrics with the Assistance of a Vacuum, Transactions, volume 67, page 212; and The Use of Stationary Cells in the Place of Rotating Cylinders in the Drying of Textile Fabrics, volume 69, page 212.

The other medal was awarded to SIDNEY B. PAINE, of Boston, Mass., for his paper on Electrical Driving in Textile Establishments, Transactions, volume 58, page 216, and also in recognition of his work contributing to the subject of electrical transmission of power in mills. The award of the first medal was virtually a confirmation of action of a previous Board of Government which had failed for the lack of a quorum just before an annual meeting.

The award for the Association medal to be given at this meeting was placed in the hands of a committee consisting of Messrs. NATHANIEL B. KERR of New Bedford, and ARTHUR H. GULLIVER of Waltham, whose decision will be made known at this meeting.

THE STUDENT'S MEDAL.

The Student's medal from the Moses Pierce fund has been awarded on the recommendation of committees of members of the Association to:

EDWARD S. SWIFT, Lowell, Mass., a graduate of the Lowell Textile School.

JOHN JOSEPH HUTCHINSON, New Bedford, Mass., a graduate of the New Bedford Textile School.

WILLIAM H. STAFFORD, Roxboro, Philadelphia, Pa., a graduate of the Philadelphia Textile School.

DONIGAN DEAN TOWERS, Marietta, Ga., a graduate of the Georgia School of Technology.

The scholarship at the New Bedford Textile School, established by the contribution of WILLIAM FIRTH, Esq., a member of this Association, has been awarded to SIDNEY WINFIELD CORSON, of Dover, N. H.

THE WEEKS BEQUEST.

The will of the late GEORGE W. WEEKS, Clinton, Mass., contains the following bequest:

"XLVIII. I give to the New England Cotton Manufacturers' Association the sum of One Thousand Dollars, ($1,000) for their library."

This will has been admitted to Probate, but the bequest will not be payable until November, 1904. Notice of the same has been given to the Association by the executors, and proper action for authorizing the receipt of the same, releasing the estate and the executors from further liability in the event of payment, has been taken by the Board of Government.

LIFE MEMBERSHIP.

Applications have been made for the privilege of commuting the dues to one single payment, and the Treasurer was authorized to accept One Hundred Dollars and to receipt for the same, but the Board of Government believe that such action should

have the approval of the Association and a motion providing for future cases will be introduced at this meeting.

THE WHITNEY TABLET.

The bronze tablet in commemoration of the work of ELI WHITNEY in ginning cotton, of which the plaster cast of the sculptor's unfinished model was exhibited at the last annual meeting, has been completed and was delivered to the Association in October, 1902, and has been kept in storage and insured ever since that time, as the building of the Eli Whitney Country Club, near Augusta, Ga., has not reached completion; and if the occurrences which have prevented the completion of that building are not overcome at an early day, the Board of Government of the Association will take action for the erection of this memorial in a suitable location where this fitting tribute of the New England Cotton Manufacturers' Association may have a prominent position suitable alike to its artistic excellence and the grateful sentiment which it portrays, as the conditions of the deed of trust are such as to maintain all the legal rights of the donors in the matter.

MEMBERSHIP.

During the past year the following members have died: THOMAS J. BORDEN, WILLIAM D. CADWELL, T. B. DALLAS, AMBROSE EASTMAN, T. C. ENTWISTLE, JOSHUA GARSED, WILLIAM H. GREENE, CHARLES D. MCDUFFIE, T. G. RAMSDELL, FREDERICK C. SAYLES, ARTHUR TURNBULL, and GEORGE W. WEEKS, biographical sketches of whom will appear in the volumes of Transactions for the year.

Among these, it is my sad duty to announce the death which occurred on April 10th of Ambrose Eastman, Esq., an honorary member of the Association and its secretary and treasurer until 1894, during which time he faithfully attended to the work of his position. He was also the counsel of the Association, in which his services were of great value, particularly in connection with

the incorporation of the organization, and advised upon various legal questions which frequently arose.

At a meeting of the Board of Government held April 18th the following resolutions were passed and spread upon the records:

Resolved: that the Board of Government place upon record a tribute to the memory of AMBROSE EASTMAN, an honorary member of this Association, who as its Secretary for twenty-nine years filled the duties of the position in a manner to receive the cordial regard of his associates, and since that time his duties as counsel have been of great value to the interests of this organization.

At the beginning of the fiscal year, the membership of the Association was 643 which has been increased by the election of 66 at the two meetings. This number has been diminished by the twelve deaths referred to, twenty-one resignations, four instances of lapsed dues and two who failed to confirm their elections, leaving a net membership of 670 in advance of this meeting.

The Board of Government has held seven meetings during the year, in addition to which there have been numerous meetings of sub-committees.

The following table shows the membership of the Association at various meetings since its foundation in April, 1865, the number elected and the number of present members.

MEMBERSHIP OF THE ASSOCIATION.

Number of Meeting.	DATE OF MEETING.	Membership.	Number of Present Members	Number Elected to Membership.
1	Apr. 20, 1865, Boston, Mass.	44	6	44
	July 19, 1865, Adj. Meeting,	—	3	42
2	July 18, 1866, Boston, Mass.	72	0	0
3	July 17, 1867, " "	—	1	10
4	Jan. 15, 1868, " "	108	0	32
5	July 15, 1868, " "	—	1	12
	Oct. 21, 1868, Adj. Meeting,	—	2	6
6	Apr. 21, 1869, Boston, Mass.	—	1	19
7	Oct. 20, 1869, " "	—	1	8
8	Apr. 20, 1870, " "	144	0	12
9	Oct. 19, 1870, " "	—	0	5
10	Apr. 19, 1871, " "	—	1	9
11	Oct. 18, 1871, " "	—	1	16
12	Apr. 17, 1872, " "	166	4	29
13	Oct. 16, 1872, " "	—	3	14
14	Apr. 16, 1873, " "	175	1	13
15	Oct. 15, 1873, " "	—	5	17
16	Apr. 15, 1874, " "	189	1	13
17	Oct. 21, 1874, " "	—	0	7
18	Apr. 21, 1875, " "	199	3	13
19	Oct. 27, 1875, " "	—	2	18
20	Apr. 26, 1876, " "	200	1	11
21	Oct. 25, 1876, " "	—	1	13
22	Apr. 25, 1877, " "	213	4	20
23	Oct. 31, 1877, " "	—	2	9
24	Apr. 24, 1878, " "	210	6	8
25	Oct. 30. 1878, " "	—	2	11
26	Apr. 30, 1879, " "	205	3	10
27	Oct. 29, 1879, " "	—	6	16
28	Apr. 28, 1880, " "	219	2	14
29	Oct. 27, 1880, " "	—	3	13
30	Apr. 27, 1881, " "	231	2	11
31	Nov. 30, 1881, " "	—	2	6
32	Apr. 26, 1882, " "	231	2	9
33	Oct. 25, 1882, " "	—	2	5
34	Apr. 25, 1883, " "	240	4	15
35	Oct. 31, 1883, " "	—	4	10
36	Apr. 30, 1884, " "	247	4	9
37	Oct. 29, 1884, " "	—	2	2
38	Apr. 29, 1885, " "	225	3	3
39	Oct. 28, 1885, " "	—	5	8
40	Apr. 28, 1886, " "	225	4	7
41	Oct. 27, 1886, " "	—	5	8

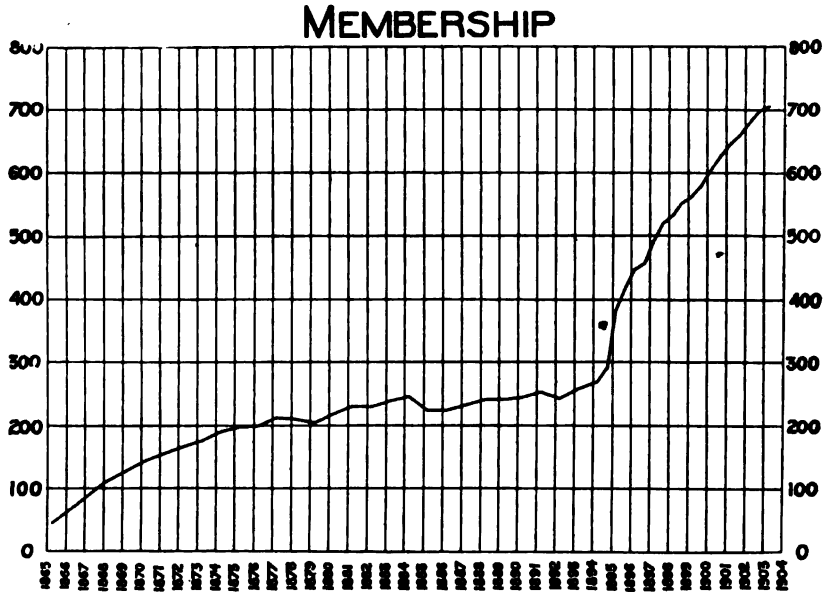
Number of Meeting.	DATE OF MEETING.	Membership.	Number of Present Members	Number Elected to Membership.
42	Apr. 27, 1887, Boston, Mass.	234	4	10
43	Oct. 27, 1887, " "	——	2	3
44	Apr. 25, 1888, " "	241	10	15
45	Oct. 31, 1888, " "	——	7	12
46	Apr. 24, 1889, " "	242	4	6
47	Oct. 30, 1889, " "	——	4	8
48	Apr. 30, 1890, " "	246	5	7
49	Oct. 29, 1890, " "	——	8	11
50	Apr. 29, 1891, " "	254	3	4
51	Oct. 28, 1891, " "	——	5	8
52	Apr. 27, 1892, " "	244	11	12
53	Oct. 26, 1892, " "	——	15	19
54	Apr. 26, 1893, " "	259	5	11
55	Oct. 25, 1893, " "	——	6	9
56	Apr. 25, 1894, " "	270	11	16
57	Sept. 27—28, 1894, Crawford House, N. H.	292	13	19
58	Apr. 24—25, 1895, Providence, R. I.	383	65	92
59	Oct. 24—25, 1895, Atlanta, Ga.	422	33	46
60	Apr. 29—30, 1896, Boston, Mass.	450	21	29
61	Sept. 22—24, 1896, Profile House, N. H.	459	17	19
62	Apr. 28—29, 1897, Boston, Mass.	495	36	43
63	Oct. 27—28, 1897, Philadelphia, Pa.	523	27	38
64	Apr. 27—28, 1898, Boston, Mass.	535	18	24
65	Sept. 27—29, 1898, Crawford House, N. H.	554	11	16
66	Apr. 26—27, 1899, Boston, Mass.	564	27	33
67	Oct. 5— 6, 1899, Montreal, P. Q.	580	18	22
68	Apr. 25—26, 1900, Boston, Mass.	603	34	38
69	Oct. 16—18, 1900, Washington, D. C.	628	35	38
70	Apr. 24—25, 1901, Boston, Mass.	647	31	33
71	Sept. 25—26, 1901, Niagara Falls, N. Y.	661	17	19
72	Apr. 23—24, 1902, Boston, Mass.	681	40	42
73	Sept. 30—Oct. 2, 1902, New York, N. Y.	699	22	24
74	Apr. 22—23, 1903, Boston, Mass.	707	41	41

The headquarters of the Association have been well patronized by members during the year and the bound volumes of the Transactions and also the books of reference and technical papers have been frequently consulted by those without the Association as well as by its members. The rooms have been called into frequent use by members for various business conferences during the year.

As the office copies of the Transactions of the Association

were destroyed by fire February 2, 1890, there is a demand for copies earlier than that date, particularly on the part of the libraries of technical institutions, and the Secretary would like information of any earlier copies which may be for sale.

The following diagram represents in a graphical manner the growth in membership of the Association from its formation.



During the past year the United States Census Bureau, by the courtesy of S. N. D. NORTH, Esq., formerly Chief Statistician of Manufactures and who has since received the appointment to the position of Director of the Census, has sent to each member of the Association a copy of the Census Reports on Textiles.

The Transactions of the following societies and periodicals are sent to the Association and kept on file.

TRANSACTIONS OF TECHNICAL SOCIETIES.

American Society of Civil Engineers,	New York.
American Society of Mech. Engineers,	New York.

American Institute of Elect. Engineers,	New York.
Boston Chamber of Commerce,	Boston.
Consular Reports, Bureau of Statistics,	Washington, D. C.
National Association of Wool M'f'rs.,	Boston.
National Electric Light Ass'n.,	New York.
Western Society of Civil Engineers,	Chicago.

LIST OF PERIODICALS KEPT ON FILE.

American Wool and Cotton Reporter,	Boston.
Boston Journal of Commerce,	Boston.
Cassier's Magazine,	New York.
Cotton,	Atlanta.
Dry Goods Economist,	New York.
Dun's Review,	New York.
Dun's Review, International Edition,	New York.
Engineering Record,	New York.
Fibre and Fabric,	Boston.
Iron Age,	New York.
Machinery,	New York.
Manufacturers' Record,	Baltimore.
Mill and Shop,	Boston.
New England Shoe and Leather Association Monthly Gazette,	Boston.
Power,	New York.
Protectionist,	Boston.
Textile Manufacturers' Journal,	New York.
Textile Recorder,	Manchester, Eng.
Southern Manufacturer,	Asheville, N. C.
Textile World Record,	Boston.

Respectfully submitted,

C. J. H. WOODBURY,

Secretary.

April 20, 1903.

THE TREASURER'S REPORT.

C. J. H. WOODBURY, TREASURER, IN ACCOUNT WITH THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION.

April 1, 1902 to April 1, 1903.

DEBTORS.

Cash,	$1,072 86	
Active membership dues,	2,660 00	
Associate membership dues,	1,530 00	
Active admission fees,	470 00	
Associate admission fees,	450 00	
Interest,	85 42	
Sale of Transactions,	222 25	
Advertising,	1,305 00	
Medal and Certificate Fund,	1,000 00	
Engraving,	23 71	
Miscellaneous,	6 43	
Students' Medal Fund,	200 00	
Whitney Tablet Fund,	16 00	
New England Cotton Manufacturers' Association Scholarship, donation of Wm. Firth,	3,000 00	
Total,		$12,041 67

CREDITORS.

Board of Government,	$100 08	
Office rent,	399 96	
Secretary and Treasurer,	1,500 00	
Amount forward,		$2,000 04

Amount forward,	$2,000 04	
Reports of meetings,	114 00	
Notices and stationery,	217 72	
Meeting expenses,	355 25	
Printing and distributing Transactions,	2,423 51	
Badges,	94 25	
Stenographer and proof,	607 83	
Advance copies of papers,	300 77	
Engraving,	190 47	
Miscellaneous,	26 30	
Postage, telegrams and express,	163 87	
Office supplies and furniture,	81 28	
Medal and Certificate Fund,	126 36	
New Bedford Textile School Scholarship Fund,	3,000 00	
Whitney Tablet,	597 90	
Securities and cash,	1,742 12	
Total,		$12,041 67

AUDITOR'S REPORT.

I hereby certify that the amounts from April 1, 1902, to April 1, 1903, are correctly cast, that all payments are properly vouched for, that the funds are kept on deposit in the name of the New England Cotton Manufacturers' Association, and that the amount of the deposit April 1, 1903, agrees with the balance in the books, viz., $542.12.

The securities in which the Association funds have been invested have been examined.

C. E. ROBERTS,

Auditor.

BOSTON, MASS., April 6, 1903.

The earnings of the Association for the year may be placed as:

539 active members at $5.00,	$2,695 00	
156 associate members, at $10.00,	1,560 00	
46 active admissions at $10.00,	460 00	
20 associate admissions at $25.00	500 00	
Advertising,	1,220 00	
Miscellaneous,	353 81	
Total,		$6,788 81

Although the disbursements of the year amount to $7,299.55 this amount is subject to a deduction of $597.90 which was paid on account of expenses of the Whitney tablet from the subscriptions in the hands of the Treasurer, from the previous year, leaving the actual expenses of the Association $6,701.65.

The bills receivable are:

Active dues,	$280 00	
Associate dues,	180 00	
Advertisements,	195 00	
Miscellaneous,	14 85	
Total,		$669 85

There are no bills payable.

The income derived from advertisments has enabled the Association to be conducted on the same basis as other technical organizations which are supported by higher assessments as well as by advertisements in their transactions. The receipts from this source have amounted in the several volumes of the Transactions to:

63	Philadelphia, October, 1897,	$385 00
64	Boston, April, 1898,	420 00
65	Crawford House, September, 1898,	450 00
66	Boston, April, 1899,	550 00
67	Montreal, October, 1899,	445 00
68	Boston, April, 1900,	580 00
69	Washington, October, 1900,	665 00
70	Boston, April, 1901,	620 00
71	Pan-American, September, 1901,	595 00
72	Boston, April, 1902,	575 00
73	New York, September — October, 1902	645 00
74	Boston, April, 1903, (already under contract),	462 50

The following table presents the finances of the Association for the past thirteen years:

Fiscal Year Ending April 1.	MEMBERSHIP. Enrollment.	MEMBERSHIP. Members Elected.	TRANSACTIONS. Volume Number.	TRANSACTIONS. Pages in Volume.	TRANSACTIONS. Pages for Year.	FINANCES. Cash Receipts.	FINANCES. Expenses.	FINANCES. Cost per Page of Transactions.	FINANCES. Cost per Member.	FINANCES. Cost per Page of Transactions for each member Cents.
1891	246	18	48 49	43 62	105	$1,142 00	$ 926 08	$8 82	$3 76	3.59
1892	254	12	50 51	129 60	189	1,260 68	1,374 46	7 27	5 41	2.86
1893	244	31	52 53	63 94	157	1,678 33	1,603 25	12 22	6 57	6.33
1894	259	19	54 55	84 86	170	1,414 58	1,807 60	10 63	7 03	4.14
1895	270 292	35	56 57	73 230	303	1,947 07	1,957 64	6 46	6 71	2.21
1896	383 422	142	58 59	310 327	637	4,579 19	3,636 31	5 71	8 59	1.34
1897	450 459	49	60 61	269 359	628	3,710 02	3,980 34	6 33	8 67	1.43
1898	495 523	83	62 63	353 453	806	4,717 08	4,333 85	5 38	8 28	1.18
1899	535 554	42	64 65	321 380	701	4,713 56	4,775 97	6 81	8 62	1.23
1900	564 580	56	66 67	464 296	760	5,237 53	5,007 23	6 57	8 63	1.14
1901	603 628	78	68 69	382 476	858	6,331 93	6,295 55	7 34	10 02	1.16
1902	647 661	52	70 71	366 379	745	6,724 23	6,035 84	8 10	9 13	1.22
1903	681 699	66	72 73	342 415	757	6,768 81	6,701 65	8 85	9 58	1.26

Respectfully submitted,

C. J. H. WOODBURY,

Treasurer.

April 6, 1903.

On motion of Mr. ALFRED E. ADAMS, duly seconded, the reports of the Secretary and Treasurer were accepted and ordered placed on file.

PROPOSED CHANGE OF NAME OF THE ASSOCIATION.

The PRESIDENT. The next matter is to vote upon the amendment to the constitution and by-laws proposed at the last meeting which changes the name of the New England Cotton Manufacturers' Association to "The American Cotton Manufacturers' Association."

The Board of Government has under advice of counsel had the following ballots prepared for the legal expression of the wishes of the members on the matters involved.

BALLOT FOR AMENDMENT TO CONSTITUTION AND BY-LAWS.

In accordance with the notice given at the last meeting, the following amendment is submitted in accordance with Article 15 of the constitution and by-laws, viz.:

Article 1, after line 3, insert the words in italics so that the sentence shall read, "Shall be eligible for active membership *in The American Cotton Manufacturers' Association.*"

In accordance with the constitution and by-laws, the above will require the assent of two-thirds of the members present and voting thereon for its adoption.

Write yes or no..... ....

BALLOT FOR AUTHORITY TO CHANGE NAME ON THE ASSOCIATION.

The Board of Government submit, in accordance with the revised laws of Massachusetts, Chapter 109, Section 9, the following proposition:

1. Shall the name of this Association be changed to The American Cotton Manufacturers' Association, provided authority be obtained for the change from the Commissioner of Corporations of the Commonwealth of Massachusetts?

2. Will this Association instruct its President and Secretary to apply in its behalf to the Commissioner of Corporations for authority to make the above change of its corporate name?

Two-thirds of the members present and voting thereon must vote in the affirmative in order to adopt the foregoing proposals.

Write yes or no.....

Name of person voting

.....

The Secretary will have the ballots distributed, and I will appoint as tellers to collect and count the ballots Messrs. JOHN TEMPEST MEATS, ARTHUR H. GULLIVER and NATHANIEL B. KERR.

The PRESIDENT. In the meantime, perhaps a word in reference to this will not be out of place. The original Association, as you may know, was the Hampden County Mill Agents' Association which was formed in 1854. In 1865, or 11 years later, it was found that the society was growing so fast that its scope was then enlarged and it was reorganized as the New England Cotton Manufacturers' Association. In the past few years we have grown very rapidly, and the suggestion was made by one of my predecessors that the name "New England" be changed, on the ground, particularly, that it had its limitations, and that the name "American," indicating the broad field which the Association is supposed to cover, be substituted in its place. This question has been discussed in various ways, until finally the Board of Government deemed it best to put the matter to ballot, allowing the members to indicate in this way just what their desire was in the matter.

The question, I think, is one of considerable importance. I do not believe that any harm will come to the Association, whether it remains the New England or whether it is changed to the American. The Association is now strong enough and on a sufficiently good footing, so it is bound to go ahead and become the one national organization of cotton manufacturers of the country. There is, perhaps, some sentiment connected with the old name of New England Cotton Manufacturers' Association, which sentiment you would expect to be strong or stronger among the older members. It is merely, gentlemen,

for you to give this matter careful consideration, and whatever is done will be done, without question, for the best interests of the Association. I might say that personally I have seen a great many times reasons for the change of the name to the American Cotton Manufacturers' Association, especially in foreign countries, where the name New England is looked upon as a decided limitation. I would not undertake, however, to put my judgment against that of the majority.

Mr. STEPHEN A. KNIGHT. Mr. President, before the votes are collected I would like to say a few words. Perhaps, as you have suggested, the older members have more sentiment in this matter than the younger ones. I most earnestly enter my protest against the change of the name of this Association. It is the New England Cotton Manufacturers' Association; it is supported by the New England cotton manufacturers and I believe for the best interests of the Association that the old name should remain. There is a Southern Cotton Spinners' Association, and I think it is eminently proper that they should maintain that name. They are a part of America also, and it seems to me that it brings a little mixture if we demoninate ourselves as the American Cotton Manufacturers' Association. We either take them in or leave them in the cold, neither of which, I think, would be desirable for us. I certainly like the old name. I like the name New England, I am a New Englander from the sole of my foot to the top of my head, and I certainly can see no particular advantage in the change and it does seem to me that the sentiment is worth something. And I believe for the best interests of the Association we should maintain the old name of the "New England Cotton Manufacturers' Association." [Applause.]

The PRESIDENT. Has anyone anything further to say? Personally, I would like to reply to Mr. KNIGHT in this way: I appreciate Mr. KNIGHT'S sentiment, and it is exactly what I supposed it would be. I am a New England man myself, and

I am very fond of the name New England. As I understand this, however, I do not see why the conditions under the new name would be different from what they are now. The Association is made up of members from all over America, a majority from New England, to be sure, but the majority of manufacturing is in New England. The Southern Cotton Spinners' Association, it is true, occupies a field which is a part of America. As I understand it, there is no desire on the part of this Association even if it changes its name, to interfere in any way with the Southern Spinners' Association. We are very desirous, either as the New England Cotton Manufacturers' Association or as the American Cotton Manufacturers' Association, to obtain members from the South and we have many who are already members of the Southern Cotton Spinners' Association. I feel that from a business standpoint the Association will prosper under either name. I have a great respect for Mr. KNIGHT and for Mr. KNIGHT'S sentiments, and as I have previously said, I believe that that is the one argument against the change. From my point of view it is the one argument and the only argument. It should be respected, however.

Mr. STEPHEN A. KNIGHT: Mr. President and gentlemen, I quite agree with our President's view of the matter, that it makes but little difference, perhaps, to the success of the institution whether it is called the New England or the American, — hence I do not see the necessity of changing the name. Our President thinks that perhaps it makes no particular difference. I think he is correct in that, I feel exactly that way myself, and if it does not, the old name of New England is good enough for me. [Applause.]

The PRESIDENT. Gentlemen, perhaps Mr. KNIGHT forces me to say that I am not a champion of this change. I am absolutely on the fence, so to speak. I am agreeable to whatever action is taken, and in my position here, even if I had a reason, I would have no right to argue the point. I simply was attempt-

ing to make a plain statement as the matter appeared to me, and I agree with everything Mr. KNIGHT says, and I should agree — absolutely agree — with whatever position is taken by the Association as a whole.

Mr. STEPHEN A. KNIGHT. Thank you, sir, as far as I am concerned.

Mr. JAMES R. MACCOLL. Mr. President, I should like to ask if the present membership is confined to New England cotton manufacturers, or if we welcome as members manufacturers from Canada and from the other states of the union.

The PRESIDENT. The present membership of the Association is 699, or practically 700, distributed as follows:

LOCATION OF MEMBERSHIP.

Maine,	19
New Hampshire,	31
Vermont,	1
Massachusetts,	324
Rhode Island,	117
Connecticut,	32
New York,	36
New Jersey,	14
Pennsylvania,	27
Delaware,	3
Maryland,	3
Virginia,	1
North Carolina,	14
South Carolina,	17
Georgia,	29
Tennessee,	3
Illinois,	1
Mississippi,	1
Louisiana,	1
Kentucky,	2
Alabama,	5

Texas,	1
Province of Ontario,	4
Province of Quebec,	8
New Brunswick,	3
England,	2
	699

You see the membership is pretty well distributed, although the majority is in Massachusetts and Rhode Island.

Mr. THOMAS HENRY SMITH. Mr. President, I would like to ask if there is any prospect of absorbing the Southern Cotton Spinners' Association in this Association if we change the name? Is that the reason?

The PRESIDENT. There has been no idea, so far as I know, of absorbing; that is, the subject has never been broached in the Board of Government since I have been a member.

Mr. THOMAS HENRY SMITH. Then should we be strictly accurate in taking the name "American"? Suppose they did the same thing — they have as much right to do it as we have, haven't they?

The PRESIDENT. Absolutely. It would not be very nice of them if they did it after we had done it. [Laughter.]

Mr. JAMES R. MACCOLL. Mr. President, while I think there is a great deal of sentiment and very proper sentiment in relation to retaining the old name, yet I feel that our Association may have a broader scope and a larger work to do than is represented by the name of New England Cotton Manufacturers' Association. If we include in our membership manufacturers from other states and from Canada, then the name should be as wide as the membership, and if we limit ourselves to New England will it not have a tendency later on to encourage the starting and the development of other associations — for

example, a Western Cotton Manufacturers' Association or a New York State Cotton Manufacturers' Association? On the other hand, if we adopt the name American Cotton Manufacturers' Association, our name expresses the breadth and scope of our work, what we intend to include and accomplish. And therefore it seems to me that there is a great deal to be said in favor of making our name broader than it is today if we are going to continue to include members from other states in the union and from Canada.

Mr. STEPHEN A. KNIGHT. I cannot understand, Mr. President, that the name limits our membership in the least. We have members today from very many of the states, we have members from Canada, and it is just as proper for them to be members under the name New England as it would be under the name of American. My point is in just these simple words —that it is a New England institution, it was created in New England and it is decidedly a New England affair, and I can but think that we are better known and will be better known and will be more successful under the name of New England than we should be to change, especially when there is no particular object to be gained by making the change.

The PRESIDENT. Well, Mr. KNIGHT, you emphasize the fact that there is no particular object; I did not mean to imply that as being my own exact idea. I said I thought the Association would thrive under either name.

Mr. STEPHEN A. KNIGHT. I did not mean to quote you, sir, or your sentiments.

The PRESIDENT. I imagine that the original idea, which, I think, originated with Mr. GOODALE, was that as the important cotton manufacturing association of the country we should have a name which could not be taken by the western cotton spinners or the southern; and simply because we are a New England organization of course, aside from the point of sentiment, there is no reason why we should not enlarge.

Mr. STEPHEN A. KNIGHT. The southern or western manufacturers will not be likely to adopt the name of New England, if that is one of the arguments.

Mr. WILLIAM D. HARTSHORNE. Mr. President, I do not wish to prolong this argument. Personally, while I appreciate fully the sentiments connected with retaining an old and established name on which all our records so far are based, at the same time it seems to me that we are reaching a time now when we ought to expand our name as well as expand our membership. The Southern Manufacturers' Association, to be sure, has been organized; a number of our members are also members of that Association. There is no reason why they should not all belong to our Association if they choose to do so. But suppose, per contra, that they should now, if we reject the name American, propose that that should be their title, as they might or as some Western concern might, what will our friends across the water think of the New England Association? Has it become a less feature than heretofore, or can it as a New England concern be considered as overtopping one which may be called an American Association? Certainly the title is something which is broader than we now possess, and if our energies are doubtless not to be confined to our title as it is today, we ought it seems to me to provide some means by which both ourselves and our friends shall appreciate that fact.

The PRESIDENT. Have all voted who wish? If so, I declare the polls closed.

The tellers, having completed the performance of their duties, were subsequently called upon by the President for their report.

Mr. JOHN TEMPEST MEATS. Mr. President, your committee respectfully submit their report, as follows: The whole number of ballots cast was 83, of which one was blank and one unsigned, leaving 81 votes, the two-thirds necessary for a choice being 54, 29 were no, and 52 were yes, just two votes short of the required two-thirds.

The PRESIDENT. Gentlemen, you have heard the report of the tellers, and whereas the majority is in favor of the change of the name, the number of votes necessary for the adoption of the amendment — that is, two-thirds of those voting — is 54; those voting yes are 52, so the amendment is rejected by two votes.

The following papers were read:

The Supply of Cotton for Fine Spinning.
HENRY G. KITTREDGE, Boston, Mass.

Discussed by Messrs. JAMES R. MACCOLL and J. D. AIKEN.

Continued Development of the Northrop Loom.
GEN. WILLIAM F. DRAPER, Hopedale, Mass.

The SECRETARY. One of the members gives notice that an amendment to the constitution and by-laws will be proposed at the fall meeting of the Association providing for life membership in the Association upon a single payment of $100 by any active or associate member. This notice is now given as a matter of record, to be taken up at the fall meeting.

The amendment referred is as follows:

LIFE MEMBERS.

ARTICLE 5. Any active or associate member by the single payment of one hundred dollars shall be exempt from all future payments for dues and shall become a life member having all the priviledges of active members.

All moneys thus paid shall be invested as a permanent fund by the Treasurer acting under the direction of the Board of Government, of which the income only shall be subject to appropriation for current expenses.

All articles of the constitution and by-laws, beginning with Article 5, shall be increased in number to the next cardinal number.

The PRESIDENT. That is all this morning. We are a little late in adjourning, and so we will adjourn till quarter past two instead of two o'clock as advertised.

Adjourned at 1.26 P. M. to 2.15 P. M.

SECOND SESSION.

WEDNESDAY AFTERNOON, April 22, 1903.

Meeting called to order at 2.15 P. M., President FISH in the chair.

The following papers were read:

Local Transportation in Mill Economics.

CLARENCE J. MESSER, Boston, Mass.
(Illustrated by the Stereopticon.)

Improving the Cotton Fibre.

DR. H. J. WEBBER, Washington, D. C.
(Illustrated by the Stereopticon.)

Improved Ginning.

CHARLES J. MCPHERSON, South Framingham, Mass.

Discussed by Mr. I. ABRAHAMS.

Current Theories of Dyeing.

JOHN W. FRIES, Winston-Salem, N. C.

Gray Goods for White Lawn Work.

DANIEL MOORE BATES, Wilmington, Del.

Report of Committee on Fire Tests of Cotton Bales.

EDWARD W. THOMAS, Charlotte, N. C.
WILLIAM D. HARTSHORNE, Lawrence, Mass.

The SECRETARY. A card from Mr. MCPHERSON states that all are invited to visit the office of the American Cotton Improvment Company, 161 High street, Fort Hill Square, Chase Building, tomorrow or any other time to see the operation of his new rotary cotton gin.

Furthermore, Mr. EDWARD W. THOMAS, who is a member both of this Association and the Southern Spinners' Association, authorizes me to extend on behalf of the latter body a cordial invitation for any member of the New England Cotton Manufacturers' Association to attend their annual meeting at Charlotte on the 14th and 15th of May. Those of us who attended the Atlanta meeting have very warm remembrances of Charlotte.

I wish to extend the notice that all, whether guests or members, will register with the clerk in the corridor, as the list of those that are present will form, I trust, in the Transactions the groundwork of many pleasant reminiscences as well as an official record. And further, if any of you in the evening or any time, or any of the ladies in your company would like to attend the exhibition of the Boston Art Club, cards of admission to that Exhibition may be procured at this desk.

The PRESIDENT. There being no further business we will now adjourn until 10 o'clock tomorrow forenoon.

Adjourned.

THIRD SESSION.

THURSDAY MORNING, April 23, 1903.

Meeting called to order at 10 A. M., President FISH in the chair.

The PRESIDENT. Gentlemen, if you will please come to order. The Secretary has a few notices to give.

The SECRETARY. It gives me great pleasure to read the following telegram:

CHARLOTTE, N. C., April 23, 1903.

C. J. H. Woodbury,
Secretary, Tremont Temple, Boston.

Good wishes for a harmonious and successful meeting.

C. B. BYRANT, *Treas., Southern Cotton Spinners' Association.*

The following papers were read:

Textile Education.
WALTER MAXWELL HASTINGS, Lawrence, Mass.

An English Textile School.
T. M. YOUNG, Manchester, England.

Discussed by Messrs. C. J. H. WOODBURY and CHARLES H. FISH.

The Use of Reheaters in Compound Engines.
GEORGE H. BARRUS, Boston, Mass.

Discussed by Mr. ALBERT A. CARY.

Stop Motion for Engines.
THOMAS HENRY SMITH, Jamestown, N. Y.

Steam Trap.
THOMAS HENRY SMITH, Jamestown, N. Y.

Discussed by Messrs. CHARLES H. FISH, ALBERT A. CARY and JOSEPH MERRIAM.

Smoke and the Determination of its Density.
ALBERT A. CARY, 95 Liberty St., New York, N. Y.

ELECTION OF OFFICERS.

Mr. PRESIDENT. The committee appointed yesterday to bring in a list of candidates for officers for the ensuing year has made its report and the ballots are now ready and will be distributed, and that vote will be taken at the present time. Mr. WALTER E. PARKER, chairman of the committee, will present the report.

Mr. WALTER E. PARKER. Mr. President, the committee appointed by the chair yesterday find that the term of office of President and two Vice-Presidents and two Directors expires by limitation this year and your committee yesterday fixed upon the following nominations for report to this convention:

FOR PRESIDENT.

HERBERT E. WALMSLEY, NEW BEDFORD, MASS.

FOR VICE PRESIDENTS.

JAMES R. MacCOLL, PAWTUCKET, R. I.
WILLIAM D. HARTSHORNE, LAWRENCE, MASS.

FOR DIRECTORS FOR THREE YEARS.

GEORGE P. GRANT, JR., FITCHBURG, MASS.
PHILIP A. MATHEWSON, FALL RIVER, MASS.

W. E. PARKER,
ARTHUR H. LOWE,
E. W. ATKINSON,
Committee.

The PRESIDENT. Gentlemen, you have heard the report; we will proceed to ballot. I will appoint Messrs. WALTER E. PARKER, ROBERT MCARTHUR and A. TENNY WHITE a committee to collect and count these ballots.

The committee proceeded to the discharge of its duty, and was subsequently called upon by the chair for its report.

Mr. WALTER E. PARKER. The tellers appointed to collect and count the ballots for officers for the ensuing year report as follows:

Whole number of votes cast, .	58
For President, HERBERT E. WALMSLEY has	56
For Vice-Presidents, JAMES R. MACCOLL and WILLIAM D. HARTSHORNE have each	58
For Directors for three years, GEORGE P. GRANT, Jr., and PHILIP A. MATHEWSON, have each	58

The PRESIDENT. Gentlemen, you have heard the report of the tellers (reading the names as reported by the committee). The same having received the required number of votes I now declare them elected as officers for the ensuing year.

ELECTION OF MEMBERS.

The PRESIDENT. We will now proceed to the election of members and associate members. The Secretary will distribute the list which has been printed and which has been approved by

the Board of Government in accordance with the by-laws. I will appoint as a committee to receive, sort and count the ballots Messrs. M. F. FOSTER, EDWIN N. BARTLETT and GEORGE C. TEWKSBURY. That committee can report at the afternoon session.

While the ballots are being distributed I cannot resist a reference to the good news in the newspapers this morning in reference to the findings of the State Board of Conciliation and Arbitration who have been investigating the corporations at Lowell. I do not mean that it is good news to find that the corporations at Lowell cannot increase wages, but it is right and proper that the findings of that board should be in accord with the statements of the officials of the corporations. It certainly could not have helped the situation if the findings of this board had been different. Just what the effect will be, I suppose, is even now problematical.

If you will please collect the ballots, gentlemen; I think they are all distributed.

Mr. ARTHUR H. LOWE. Mr. President, I would like to move that Mr. FOSTER be requested to cast one ballot as representing the unanimous choice of the members. I think probably the members would like to keep the lists of new members which they have, and I think that would be perfectly satisfactory and save some time.

Mr. STEPHEN A. KNIGHT. I second that motion.

The PRESIDENT. Gentlemen, it is moved and seconded that Mr. FOSTER be instructed to cast one ballot for the list of members which you have in hand.

The question was put to vote and the motion was declared unanimously carried.

The PRESIDENT. Mr. FOSTER has cast one ballot for the names recommended for membership by the Board of Government and they are therefore unanimously elected.

The list of applicants for membership who were thereby declared elected was as follows:

FOR ACTIVE MEMBERSHIP.

WILLIAM F. ARTHUR, Supt. Nashua Mfg. Co., Nashua, N. H.
By Mr. R. S. MILLIKEN.

J. W. BAILEY, Dir. The A. French Textile School, Atlanta, Ga.
By Mr. H. P. MEIKLEHAM.

FREDERICK D. BALLOU, Supt. W. A. Slater Mills, Jewett City, Conn.
By Mr. E. R. BALLOU.

ALBERT FARWELL BEMIS, Pres. Jackson Fibre Co., (Jackson, Tenn.), P. O. Box 5173, Boston, Mass.
By Mr. ALPHONSE S. COVEL.

HARRIS H. BUCKLIN, Asst. Treas. Interlaken Mills, Providence, R. I.
By Mr. EDWARD C. BUCKLIN.

JOHN L. BURTON, Agt. Newmarket Mfg. Co., Newmarket, N. H.
By Mr. RUSSELL W. EATON.

DANIEL CLARK, Supt. Williams Duck Co., Moodus, Conn.
By Mr. ARNOLD B. SANFORD.

E. W. DAVENPORT, Supt. Brighton Mills, Passaic, N. J.
By Mr. WILLIAM L. LYALL.

ARTHUR J. DRAPER, Treas. Pell City Mfg. Co., Pell City, Ala.
By Mr. EDW. T. GARSED.

JOHN H. ESTES, Cotton Manufacturer, Fall River, Mass.
By Mr. JOHN F. HAMLET.

SIMON FRIEDBERGER, Pres. Friedberger Mfg. Co., Logan Station, Germantown, Philadelphia, Pa.
By Mr. ARNOLD B. SANFORD.

PETER HARDMAN, Supt. American Thread Co., Willimantic Mills, Willimantic, Conn.
By Mr. E. S. BOSS.

W. G. HARTFORD, Agt. Hamlet Textile Co., Woonsocket, R. I.
By Mr. JAMES R. MACCOLL.

WALTER M. HASTINGS, Asst. to Agt., Arlington Mills, Lawrence, Mass.
By Mr. WM. D. HARTSHORNE.

ERNEST L. HERSOM, Supt. Nockege Mill, Fitchburg, Mass.
By Mr. W. F. STILES.

JOHN H. HOLT, Supt. Totokett Mills Co., Versailles, Conn.
By Mr. JOHN ECCLES.

WM. E. HOOPER, Mgr. Woodberry Div. of Mt. Vernon Woodberry Co., Woodberry, Baltimore, Md.
By Mr. JOHN H. WHITTEN.

JOHN L. JEROME, Treas. Overland Cotton Mill Co., Denver, Colorado.
By Mr. C. H. FISH.

GORDON A. JOHNSTONE, Agt. Danielson Cotton Co., Danielson, Conn.
By Mr. HENRY D. MARTIN.

VLADIMIR MALININ, M. E., Prochoroff Three Hill Mfg. Co., Moscow, Russia.
By Mr. C. H. FISH.

HENRY G. MCCARTER, Mgr. John Farnum & Co., Conestoga Mills 2 & 3, Lancaster, Pa.
By Mr. FRANK J. HALE.

ROBERT B. MEIKLE, Supt. Lorraine Mfg. Co., Westerly, R. I.
By Mr. JAMES R. MACCOLL.

WILL NELSON, Head Instructor of Weaving, Lowell Textile School, Lowell, Mass.
By Mr. W. M. HASTINGS.

FREDERICK OTT, Supt. Hamlet Textile Co., Woonsocket, R. I.
By Mr. JAMES R. MACCOLL.

THEODORE ELLIS RAMSDELL, Agt. Monument Mills, Housatonic, Mass.
By Mr. JNO. H. C. CHURCH.

SAMUEL STEWART, Supt. Boston Duck Co., Bondsville, Mass.
By Mr. E. G. CHILDS.

WILLIAM J. STEWART, Supt. H. N. Slater Mills, Webster, Mass.
By Mr. ALPHONSO F. WHITE.

D. IRVING TRAINER, Agt. Lincoln Mfg. Co., Chester, Pa.
By Mr. BYRON F. CARD.

JAMES EARLE WHITIN, Pres. Uxbridge Cotton Mills, Whitinsville, Mass.
By Mr. FRED B. WHITIN.

HENRY WILLIAMS, Supt. Canoe River Mill, Taunton, Mass.
By Mr. JOHN J. CONNELL.

ELIAS S. WILLIS, Supt. Boott Cotton Mills, Lowell, Mass.
By Mr. H. S. HOUGHTON, Sr.

SAMUEL F. WINSPER, Supt. City Mfg. Co., New Bedford, Mass.
By Mr. GEO. A. AYER.

WM. I. WOODWARD, Agt. Shetucket Co., Norwich, Conn.
By Mr. W. G. HENDERSON.

FOR ASSOCIATE MEMBERSHIP.

EDWARD H. BEST, Woolen Merchant, 224 Purchase St., Boston, Mass.
By Mr. A. C. FREEMAN.

GEORGE L. BROWNELL, Inventor and Builder of Improved Twisting Machinery, Station A, Worcester, Mass.
By Mr. WILLIAM L. LYALL.

CHARLES HENRY DAVIS, C. E., Charles Henry Davis & Partners, 25 Broad St., New York, N. Y.
By Mr. C. H. FISH.

HUGH DE HAVEN, Prop. De Haven Mfg. Co., 50-54 Columbia Heights, Brooklyn, N. Y.
By Mr. ARNOLD B. SANFORD.

L. L. FLEMING, V. P. and Gen. Mgr. American Cotton Co., 25 Broad St., Lock Box 240, New York, N. Y.
By Mr. W. S. SOUTHWORTH.

CHARLES C. HEDRICK, Mechanical Engineer, Lowell Machine Shop, Lowell, Mass.
By Mr. C. H. FISH.

ELWOOD E. TAYLOR, N. E. Mgr. Under-Feed Stoker Co., 430 Board of Trade Bldg., Boston, Mass.
By Mr. GEORGE C. TEWKSBURY.

GEORGE H. WATSON, Pres. The Northern Engineering Co., 95 Liberty St., New York, N. Y.
By Mr. GEORGE C. TEWKSBURY.

The PRESIDENT. There being no further business before the meeting, we will now adjourn until two o'clock this afternoon.

Adjourned.

FOURTH SESSION.

THURSDAY AFTERNOON, APRIL 23, 1903.

Meeting called to order at 2 P. M., the President in the chair.

The PRESIDENT. Gentlemen, if you will come to order, I have a notice from the Secretary of a series of resolutions to be offered at this time.

Mr. JUSTIN A. WARE. This being the closing session of the convention, I would respectfully offer this resolution:

Resolved, That the sincere thanks of the Association be extended to His Honor CURTIS GUILD, Jr., Lieut. Governor of the Commonwealth of Massachusetts for his able, vigorous, statistical and suggestive address.

Also to HENRY G. KITTREDGE, Boston; CLARENCE J. MESSER, Boston; GEORGE H. BARRUS, Boston; DR. H. J. WEBBER, Washington, D. C.; CHARLES J. MCPHERSON, South Framingham, Mass.; T. M. YOUNG, Manchester, Eng.; ALBERT A. CARY, New York City; EDWARD N. VOSE, New York City; JOHN H. MCGIBBONS, New York City; H. NEWELL WARDLE, Philadelphia; for the very entertaining and instructive papers presented the Association at its 74th meeting.

The PRESIDENT. Gentlemen, you have heard the resolutions which have been offered. What will be your wish in reference to these?

Mr. STEPHEN A. KNIGHT. I move their adoption.

The motion was seconded and unanimously adopted.

The following papers were read:

Export Markets for American Cotton Goods.
EDWARD N. VOSE, 290 Broadway, New York, N. Y.

Discussed by Mr. E. G. PRESTON, Secretary of the Chamber of Commerce, Boston, Mass.

Factory Tenements.
ARTHUR H. GULLIVER, Waltham, Mass.

Discussed by Messrs. CHARLES H. FISH and JUSTIN A. WARE.

Cotton and Cotton Goods at the Louisiana Purchase Exposition.
JOHN H. MCGIBBONS, Eastern Representative,
23 West Thirty-fourth St., New York, N. Y.

Native Spindle Whorls of North America and Adjacent Territory.
H. NEWELL WARDLE,
Academy of Natural Science, Logan Square,
Philadelphia, Pa.

Census of Cotton Spindles in the United States.
C. J. H. WOODBURY, Boston, Mass.

The PRESIDENT. Gentlemen, there seems to be no further business before the convention. I regret that I am to be deprived of the pleasure of presenting to you my successor, Mr. WALMSLEY, who is absent. I must say in closing my term of office as president of the New England Cotton Manufacturers' Association that I feel that I ought to acknowledge the uniform kindness and consideration which you, the members, have at all times accorded me.

Also to our Secretary, Mr. WOODBURY, I wish to give this public acknowledgment for his valuable, personal assistance.

I now return to the ranks and shall continue to do all that I can for the benefit of the Association.

Gentlemen, I now declare this convention dissolved. [Applause.]

(Adjourned at 4.10 P. M.)

Attest:

C. J. H. WOODBURY,

Secretary.

TRANSACTIONS.

FIRST SESSION.

WEDNESDAY MORNING, April 22, 1903.

The Association met in Chipman Hall, Boston, at 11 A. M., President FISH in the chair.

THE PRESIDENT. The first paper on the programme is The Supply of Cotton for Fine Spinning, Mr. HENRY G. KITTREDGE, Boston, Mass.

*THE SUPPLY OF COTTON FOR FINE SPINNING.

HENRY G. KITTREDGE, Boston, Mass.

The most important fibre entering into the commercial life of the textile industry, is cotton, and more so today than ever before in all of its history from time immemorial. Never before was it so universally used for the clothing of people of all nationalities and of all conditions. It is the textile fibre of the rich and of the poor. It is the only fibre of value that nature furnishes all prepared for immediate manufacture. Its physical structure and chemical constitution adapt it most peculiarly to nearly all purposes of fabrication at a relatively low cost. Aside from its intrinsic merits as a textile material, its low cost and ease of manufacture is the chief reason for its almost unlimited use. At its present cost, relative to that of wool, flax, silk and other like fibres, it will hold its pre-eminence for generations and centuries to come. Its relative cost or price must be taken as its main stay, so that there shall be primarily an inducement for its manufacture, and secondarily an inducement for its cultivation. If both of these factors are present, it may be said that there is no limit to its production and consumption.

The cultivation of ordinary cotton of one inch staple and below, is not a difficult thing within the tropical and semi-tropical regions of the world, but it is quite a different matter when applied to that of 1 ¼ inch and above stapled cotton, about which I shall speak more particularly. There is no immediate cause for alarm that

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* For further reference on this subject see Transactions as follows: Vol. 27, p. 84, EDWARD ATKINSON, Varieties of Cotton; Vol. 69, p. 140, Dr. WALTER H. EVANS, The Cotton Plant; Vol. 69, p. 157, Dr. L. H. DEWEY, American Grown Egyptian Cotton; Vol. 73, p. 182, S. N. D. NORTH, The World's Supply and Consumption of Cotton.

there will be a shortage in the supply of long stapled cotton for the current demands of manufacture, but should the demand increase, as it has within the last decade or so, the situation may be alarmingly changed, and the difficulty of securing a supply keenly realized. It is not infrequently declared that when this condition of demand and supply arrives, the latter will be forthcoming from regions where it is now obtained or from new fields. This does not necessarily follow, as the cost of cultivation may be so great as to be no incentive for its growth at a price which the conditions of manufacturing will permit being paid for it. It may be said that the demand, today, at a price, is greater than the supply. If long stapled cotton for fine spinning could be had at a comparatively low cost to the manufacturer, it would be used in much larger quantities than it is now, for there exists a want, which the increasing prosperity of the people of the civilized world warrants, for finer and better fabrics. So long as there is a growing want for a higher grade of goods, requiring the best growths of cotton, its gratification would seem to be within the lines of a judicious policy in manufacture, if for no other purpose than as a relief to the general industry from the competition in the lower grade of goods.

The consumption of cotton for fine spinning is confined almost wholly to that raised along the South Atlantic sea coast and in the valley of the Mississippi river of the United States, and in the valley of the Nile, Egypt. What is grown elsewhere, as on the islands of the Pacific Ocean and in South America, is either too small in amount to be taken account of, or not suitable for fine spinning, though, possibly, possessing the necessary length of staple. Great Britain increased her consumption of Egyptian cotton during the twelve years ending with the season of 1901–02, over 38 per cent., and of Sea Island cotton over 9 per cent. For the same period the Continent increased its consumption of Egyptian nearly 112 per cent., and of Sea Island nearly 200 per cent. During the same time the United States increased its consumption of foreign cotton, chiefly Egyptian, over 680 per cent., and of

Sea Island over 150 per cent. The total absolute increase was 374,453 bales of Egyptian and 36,065 bales of Sea Island.*

Should this tendency of increase continue for the next ten or twelve years, there will be a shortage in the supply from any reasonable expectancy of increase in the production of Sea Island cotton in its present region of growth, or of Egyptian cotton, even with the new irrigation scheme in full operation. To meet the deficiency, the most promising region is through the valley of the Mississippi river; but how much this can be depended on is a mooted question, and if there, or anywhere else, the cultivation has to be forced or carried on at an unusual expense, the cost of the product will prevent or discourage its growth. It is well known that excellent cotton can be raised on the bottom lands of many of the rivers of our Southern States, but how far it can be extended at a cost that will induce its cultivation and be acceptable to the demands of manufacture is uncertain.

There are no people better able to gratify a want for high grade cotton goods than those of the United States; and this is shown in the increasing demand among them for such goods. In 1890, the per capita consumption of Egyptian and Sea Island cot-

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*The authorities for the consumption of Egyptian and Sea Island cotton are Ellison & Co., the New York Commercial and Financial Chronicle, and the Bureau of Statistics, Treasury Department, Washington, D. C., the latter furnishing the figures of imports which are taken to be equivalent to consumption in the United States. The yearly average consumption of two seasons is taken so as to equalize abnormal conditions that might apply to any one season.

			Egyptian.	Sea Island.
Great Britain.	Yearly average consumption for seasons, 1888-89 and 1889-1890,	Bales	238,580	23,753
" "	Yearly average consumption for seasons, 1900-01 and 1901-02,	"	328,885	25,938
Continent.	Yearly average consumption for seasons, 1888-89 and 1889-1890,	"	173,005	2,031
"	Yearly average consumption for seasons, 1900-01 and 1901-02,	"	376,525	5,993
United States.	Yearly average consumption for seasons, 1888-89 and 1889-1890,	"	11,842	18,628
" "	Yearly average consumption for seasons, 1900-01 and 1901-02,	"	92,470	49,536

tons in the United States was less than a quarter of a pound, while in 1900 it had risen to about one pound, and today it is more. This is enough to show the growing importance of such cotton to meet the demands of our own people, and the latter's appreciation of a superior quality of fabrics. Much of this increased consumption appears in hosiery and knit goods, but it is well known that most of it is for woven goods. There are no fully satisfactory statistics to show the real effect of the Sea Island and Egyptian cottons upon our finer qualities of cotton fabrics, as those made of 60's and above yarn.

In 1900, there were 77,195,871 pounds of yarn spun in our mills of No. 41 and over, against 34,845,826 pounds in 1890, and this is as near to fine spinning as the censuses of 1890 and 1900 furnish us. About 77 per cent. of this quality of spinning, in 1900, was done in Massachusetts and Rhode Island. A little was done in North Carolina (886,200 pounds), enough to be of interest as showing a tendency in manufacturing in the South, where for other or lower counts of yarn, as well, a small quantity of Sea Island and Egyptian cottons was used in conjunction with some from the long stapled sections of the Gulf States. Of the total quantity of yarn spun in the United States, in 1900, only a little over 5 per cent. of it was as fine as No. 41 and over; but some — how much is not known — of the long stapled cotton is not spun to its ultimate degree of capacity, even for fabrics of superior quality.

An approximate idea may possibly be had of the amount of long stapled, upland American cotton used in the United States for fine spinning, as represented by No. 41 and over, by taking the 1900 census figures, which give the consumption of Sea Island and Egyptian cottons at 74,287,566 pounds, and the total production of fine yarn at 77,195,871 pounds. Allowing a waste of 30 per cent. on the assumption that these cottons were combed, we have a yarn production from them of 45,001,297 pounds, which, deducted from the total amount of yarn, leaves 32,194,574 pounds of yarn made from the upland variety. As much of this upland cotton for the lower numbers in the range

from No. 40 and upward is not combed, and cannot be so readily assumed as for the numbers for which the Sea Island and imported Egyptian cottons are used, the average waste in manufacture must be less than 30 per cent. I have, therefore, for purposes of calculation, called the percentage of waste on this cotton 20, which would make the 32,194,574 pounds of yarn represent 40,243,217 pounds of raw cotton, or 80,486 bales of 500 pounds each.

This, at least, is a plausible assumption of the amount of long stapled upland cotton that was used in our domestic manufactures of 1900. Today the amount may be placed at 100,000 bales. There are no means for ascertaining how much more of this kind of cotton is grown and exported for fine spinning.

I assume that all Sea Island and Egyptian cottons go into fine spinning. While this may be true concerning the Sea Island, it is not strictly so concerning all the Egyptian that is grown, but any deficiency in the amount of the latter, in this respect, is supplied by other suitable cotton that is picked up here and there in other parts of the world of which no account is taken in my calculations, so that it may be safely said that the amount of cotton now grown for fine spinning is represented in the quantities of Sea Island and Egyptian cottons, together with whatever may be cultivated of the long stapled upland cotton of the United States.

The production and consumption of Sea Island and Egyptian cottons for a series of years are equivalent. The average yearly consumption of these cottons, by the mills of Great Britain, for the three seasons of 1899-1900 to 1901-02, was 269,410,280 pounds, producing 188,587,196 pounds of yarn, allowing a waste in manufacture of 30 per cent. It is estimated that seven and a quarter million spindles were engaged in spinning this quantity, which would allow about 26 pounds of yarn for the spindle product a year.* This production of yarn per spindle

* The fine spinning trade (that is, the division spinning Sea Island and Egyptian cottons) taken altogether only amounts to 7¼ million spindles out of, say, 45 millions all told.—*Textile Mercury, Manchester, England.*

shows at once that these cottons were not spun to their ultimate, practical capacity, for had they been it would have required over 9,650,000 spindles to have spun the amount — allowing 12 pounds of yarn per spindle for Sea Island and 20 pounds for Egyptian. If this consumption of 26 pounds per spindle should be applied as the proper amount for Continental and American mills, there should be 7,350,000 spindles on the Continent and 2,300,000 spindles in the United States, engaged in the spinning of Sea Island and Egyptian cottons, or, for the world, a total of 16,900,000 spindles.† The average total consumption of these cottons is 627,341,930 pounds yearly, which if spun to their ultimate capacity would require over 22,200,000 spindles, instead of 76 per cent. of this number, as is the case now.‡

In arriving at the average spinning capacity of Sea Island and Egyptian cottons, I have taken the Georgia Sea Island cotton as typical of that class of cotton, as Georgia supplies two-thirds of it, and the Mitafifi variety as typical of the Egyptian. The average spinning capacity of these cottons I have placed at No. 100 for the Sea Island and No. 70 for the Egyptian. The opinions of spinners vary as to the spinning capacity of the different varieties of the Sea Island and Egyptian cottons for

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† I submitted my estimate to Ellison & Co., and in reply they write: "It is almost impossible to ascertain the exact number of spindles employed in the spinning of Egyptian and Sea Island cottons, but we doubt if the consumption amounts to much more than 25 to 27 pounds per spindle" for the mills of Great Britain.

‡ Average yearly deliveries to mills of Egyptian and Sea Island cottons for the three seasons of 1899-1900, 1900-01 and 1901-02. Authorities are Ellison & Co. and the New York Commercial and Financial Chronicle. The average weight of bales is taken at 730 pounds for Egyptian and 390 pounds for Sea Island.

Great Britain.	Egyptian	257,690,000 lbs. cotton.	
	Sea Island	11,720,280 " "	
		269,410,280 " "	Production 188,587,196 lbs. yarn.
Continent.	Egyptian	270,100,000 lbs. cotton.	
	Sea Island	2,511,830 " "	
		272,611,830 " "	Production 190,828,281 lbs. yarn.
United States.	Egyptian	66,000,000 lbs. cotton.	
	Sea Island	19,319,820 " "	
		85,319,820 " "	Production 59,723,874 lbs. yarn.

good work. Much depends on the weave and character of the fabric to be made, upon the machinery employed and upon the views of the spinner or manufacturer, whether it is good economy to spin cotton to its utmost capacity, or to within considerable numbers of it, for the production of perfect goods with the least possible waste.* If I have erred in the average numbers, as

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*The views of two of the leading spinners of fine cotton yarns in the United States are given below, regarding Sea Island, Egyptian and long stapled upland cottons.

Views of Spinner No. 1.

Commercial Sea Island cotton, not selected crop lots that sell at 60 to 70 cents per pound, but that which is known as planters' crops, selling at 35 cents a pound, can be run successfully in filling up to 220's, possibly a trifle finer, and in warps up to 150's.

The highest grade of Egyptian, while it is no longer in staple than the lower grade, has a much finer fibre, and can be run in filling up to 110's and in warps to 60's. There is quite a little 70's Egyptian warps made, but it does not produce as much as that from the Allen seed. Allen seed cotton can be handled successfully in warps from 50's to 70's, and in filling up to 125's.

Georgia Sea Island cotton, as it is known, or Floridas, will spin 80's to 120's warp, and 140's to 200's filling. This is based wholly on selection.

Peeler cotton can be spun, successfully, in warps from 40's to 55's, and in filling from 50's to 70's.

The relative difference as to staple is that the selected planters' crops of Sea Island cotton run from 1¾ inches to 2¼ inches.

Ordinary Sea Island, 1¾ to 2 inches.

Egyptian, 1¼ to 1⅜ inches.
Georgia Sea Island, 1⅝ to 1⅞ inches.
Allen seed, 1⅜ to 1⅝ inches.
Peeler cotton, 1¼ to 1⅜ inches.

Views of Spinner No. 2.

Of the same opinion.

Agree with this as to length and fineness of fibre. My experience, however, is that one cannot spin, successfully, finer than 90's filling and 50's warp out of Egyptian. Allen seed of 1⅜ inch staple can be handled, successfully, in warps up to 60's and filling up to 100's. Allen seed of 1½ inch staple will spin 80's warp and 120's filling.

Georgia Sea Island 80's to 100's warp; 125's to 140's filling. Florida Sea Island, 100's to 120's warp; 150's to 200's filling, based on selection.

Peeler cotton, 1¼ inch staple, will spin 50's warp and 60's filling.

The relative difference as to length of staple is, in my judgment, that selected planters' crop of Sea Island will not run longer that 2 inches.

Ordinary Sea Island (Florida), 1¾ inches.
Egyptian, 1¼ inches.
Georgia Sea Island, 1⅝ inches.
Allen seed, 1⅜ to 1½ inches.
Peeler, 1¼ inches.

given above, it has been on the side of their being too low than too high. For all purposes of computation for consumption and spindleage they will answer.

If the demand for these long stapled cottons continues, as there is every indication that it will, and to an extent comparable with the increase for the last decade, a very much larger supply must be had from some one or more sources. The present sources of supply, as is well known, are the islands and coast lands of South Carolina, Georgia and Florida, the valley of the Nile, and the rich river bottom lands of the middle Southern states. Can these be made to increase their supply? They can be, undoubtedly, to an almost unlimited extent if the inducements are strong enough to warrant it. It is a question of planters' remuneration and the market price for the staple.

Unless the incentive for cultivation is an extraordinary one, in which the difference in the cost of production and the price obtained for the staple is sufficiently large to allow of a very satisfactory profit, there is no apparent likelihood of the Sea Island cotton production exceeding 40,000,000 pounds, or about 100,000 bales.* The production of Sea Island cotton for the season of 1896-97 was 103,516 bales. This is the maximum yield in the history of the industry, and should not be reckoned on as an ordinary one for a series of seasons. A 40,000,000-pound production means the spinning of 26,000,000 pounds of yarn, which, if spun to its utmost, practicable fineness, would require 2,200,000 spindles. The Sea Island cotton fields (See accompanying map.) of the United States lie close to the coast of South Carolina, in the southern interior of Georgia and in the northern interior of Florida. The principal productive fields of Georgia and Florida are in the upper regions of the Altamaha River and northeast thereof, and in the valleys of the Suwanee River and its northern affluents. Broadly speaking, the natural

* Upon submitting this estimate of the maximum production of Sea Island cotton to the statistician of the Division of Statistics, United States Department of Agriculture, he replied: "Your estimate of the maximum production of Sea Island cotton (100,000 bales) is a reasonable one."

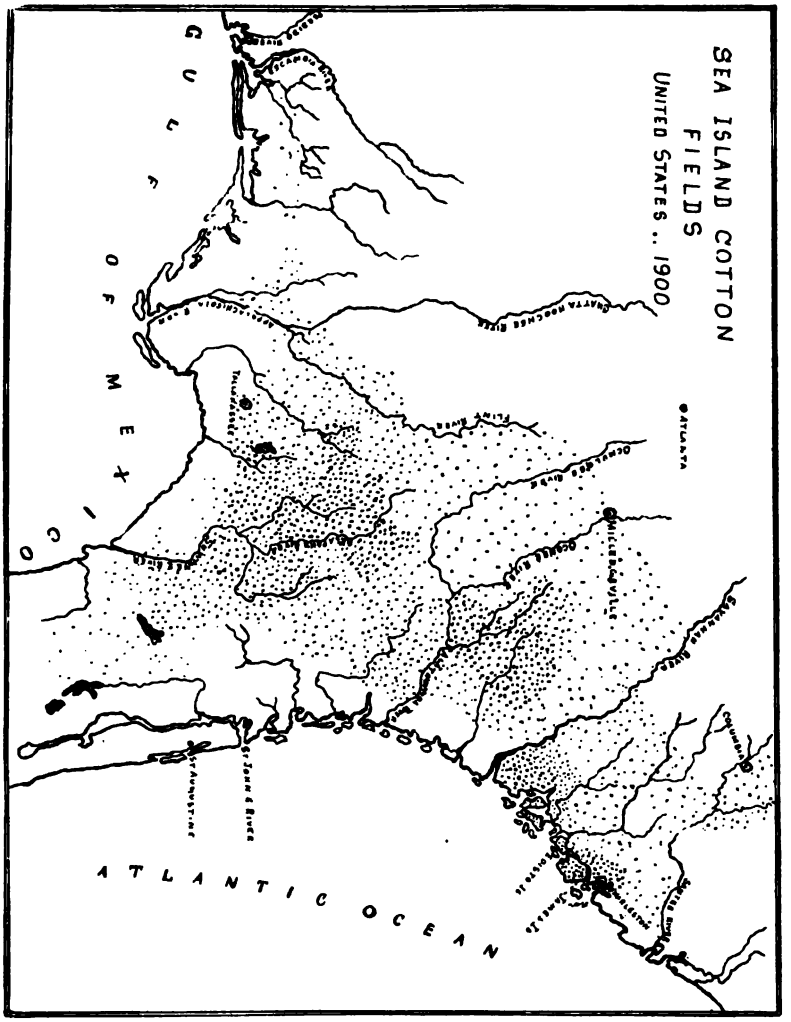

FIGURE 1.— SEA ISLAND COTTON FIELDS OF THE UNITED STATES.

Sea Island cotton fields lie between the Santee River in South Carolina to the Appalachicola River in Florida, and within 150 miles of the coast. Wherever tillable, the alluvial lands, marshes, swamps and live oak lands of the coast in South Carolina, and

the long leaf pine and oak regions of Georgia and Florida, are where the largest yields are obtained.† There is practically no cotton grown contiguous to the sea coasts of Georgia and Florida.

In studying the 1900 census of the yield of Sea Island cotton, it should be borne in mind that in tabulating the cotton for South Carolina, Georgia and Florida, all cotton was classed as Sea Island which was sold for more than ten cents a pound, and by this method considerable quantities of hybrids — crosses between Sea Island and uplands — were taken account of in addition to the pure varieties. Much of the cotton grown in the interior, or quite a distance from the coast, was of this character.

The longest stapled and finest fibered Sea Island cotton is grown on the islands and near the coast of South Carolina, for 50 miles south of Charleston. Why this is so is not easily explained, only it is the experience of planters that cotton grown outside of this region deteriorates in these qualities. The finest growths, in every respect, have been those of Edisto Island, a short distance south of Charleston. The acme of cultivation has been achieved here. The staple of very choice selections is sometimes 2¼ to 2½ inches long. This length is very rare, and a staple of 1¾ to 2 inches is excellent. There is no particular inducement to a planter to raise and prepare for market these high grade cottons. Their yield and cost of preparation are not commensurate with the price obtained for them. To obtain fineness of fibre is as costly as length of staple, if it has to be a matter of selection and high cultivation. It may almost be said that a difference of $\frac{1}{1600}$ of an inch in the diameter of

† In response to a query, W. W. Gordon & Co., cotton factors and commercial merchants, Savannah, Ga., write me: "All the territory in southern Georgia and middle Florida is adapted to either Upland or Sea Island cotton, and the acreage each year depends to a considerable extent upon the relative prices of the two cottons during the preceding season. Sea Island is not profitable unless it sells for more than double the price of upland cotton. In other portions of Georgia where the clay comes near the surface, and in the alluvial lands along the river bottoms, the Sea Island grows almost into a tree, and does not make the same lint as that from the stalks grown upon the piney or light sandy land.

FIGURE 2.—SEA ISLAND COTTON.

the fibre, in these highly cultivated cottons, is the difference between a cotton with a commercial value and one that has only a speculative value — a value of fancy.

These staples of Sea Island cotton are from specimens sent me by I. JENKINS MIKEL, Edisto Island, in 1895. He writes concerning them, that the sample *A* was grown by WILLIAM S. EDINGS, of this Island. "It is perhaps the finest cotton grown in the world. Mr. EDINGS does not propose to plant any more of it, as he has been advised by experts that there is no sale for it at paying prices, or perhaps at any price. Its possible value is entirely speculative or one of fancy." Sample *B* was sold in 1895 at 53 cents a pound; sample *C* at 40 cents; and sample *D* at 25 cents. The staples, as here shown, are from single seeds. My examinations of their fibres show that those of *A* are very fine, — $\frac{1}{2500}$ of an inch average major diameter, $\frac{1}{1300}$ maximum, $\frac{1}{3400}$ minimum,— perfectly and regularly convoluted, and altogether indicative of intense cultivation. The fibres of *B* are not so fine as those of *A*,— $\frac{1}{2200}$ of an inch average major diameter,— but otherwise there is no perceptible difference. The fibres of *C* and *D* are still coarser and less perfect, but excellent. The relative average diameters of the fibres of the four samples may be seen in black marks above them representing their magnification 400 times.

In speaking of the different grades of Sea Island cotton, for the season of 1899-1900, in the Charleston market, the United States Department of Agriculture remarked that the extra and extra-fine grades at 35 and 50 cents exceeded the demand, and were slow of sale at constantly decreasing prices, while just the reverse was the case with the lower grades, which sold at 18 to 24 cents a pound, the demand exceeding the supply, resulting in steadily advancing prices. This is the general experience in Sea Island cotton cultivation, and the demand is not sufficient to encourage the growth of the highest types of cotton. It is, therefore, a commercial problem whether it pays to raise cotton exceeding 1⅝ to 1¾ inch staple with an average diameter of fibre exceeding $\frac{1}{1500}$ to $\frac{1}{1800}$ of an inch. The time may come

when it will. At the best, no doubt, the supply of these extra-extra and extra-fine grades will always be very limited, and as yet they have not been produced anywhere other than on the islands of South Carolina. It probably will be a long time before much of these high grades will be wanted. The Sea Islands of South Carolina will long, and perhaps forever, be the nursery of the Sea Island, or long stapled, cotton cultivation. Without an occasional renewal of seed from them the growth of long stapled cotton elsewhere, declines, whether it be in the interior of Georgia and Florida or in the valley of the Nile.

The great care, judgment and experience required for the cultivation of long stapled cotton, even where climate and soil favor its production, will always exert a restraining influence over its extension. It demands a higher order of intelligence, and a more persistent and well directed energy, than are required for the cultivation of the ordinary short stapled cotton. The nearer perfection is attained in agriculture, as in anything else, the greater is the need of circumspection, which, in itself, naturally sets a limit to the exercise of mental or physical effort and a curtailment of anything dependent upon it. The cultivation of Sea Island cotton is expensive, tedious and oftentimes unremunerative. The hand hoe is the instrument mostly depended on. In fact, it has been only within the last 30 years that the plow has come into anything like general use.

Not many years ago I had the pleasure of visiting Capt. WILLIAM G. HINSON, James Island, opposite Charleston. His method of Sea Island cotton cultivation is mainly that of selection. The nursery plot for his plantation is a highly fertilized quarter of an acre of land. A few of the most thrifty and fruitful plants are chosen each season for their seed for replanting in this quarter acre plot. The seeds from the other plants are used for sowing the entire plantation, from which he expects a yield of 350 pounds of lint per acre. After the cotton is gathered, it is sorted by hand, over screens, and all stained and defective locks thrown out. The necessity of all this carefully

conducted system is sufficient to deter one from cultivating this kind of cotton unless it promises remarkably good returns.

The United States Department of Agriculture is doing a great deal in extending the cultivation of long stapled cotton in the South, and its efforts are represented as receiving encouraging returns. All methods that experience has demonstrated as of value are utilized, as the use of seed of cotton that has shown qualities desirable to propagate, whether exotic or native, by hybridization, cross breeding or selection. For length of staple and fineness of fibre, the Sea Island variety is nearly always depended on as the basis for improvement. Experiments are being made, under scientific supervision and favorable conditions, with the best of Egyptian seed in different parts of the South, from South Carolina to Texas, in the hope and expectation of eventually securing a sufficient yield to satisfy the needs of our spinners without the necessity of their relying upon the product of Egypt. There is no expectation of obtaining any considerable supply of cotton with a staple equal in length to that of the genuine Sea Island, but rather a medium lengthed staple comparable with the Egyptian and our own Allen seed. For the latter, the Department believes that the "acreage can be greatly extended"; and Dr. H. J. WEBBER, who has charge of the laboratory of plant breeding, writes me that in his opinion this extension of acreage will be accomplished in the near future. The tests that have been made in Georgia with Egyptian seed indicate results "as good if not better than the best imported fibre." *

Experiments have been conducted in the cultivation of the Yannovitch Egyptian cotton in Arizona, near Phoenix, but I

* Dr. WEBBER writes me: "In order to render Egyptian cotton thoroughly successful in this country, it remains simply to put it through a course of selection to slightly increase the yield. This we are now doing with every hope of success. We may be able to increase an output of medium lengthed staple by means of some of our hybrids between Sea Island and upland. This field of experiments is very promising, and some of the hybrids which we already have on hand give evidences of being valuable."

should not expect to see any great extension of it there, though the conditions in that region are represented to be quite similar to those in the Nile valley. After it has been demonstrated for a series of seasons that Egyptian cotton can be successfully raised in the South, the extension of its cultivation will depend on how far the planters can be induced to devote to it the systematic care that it requires.

The possibilities of the soil of the Southern States for raising long stapled cotton may not yet be fully known or realized. Dr. P. H. MELL, of the Alabama Polytechnic Institute says: "Before the Civil War, the lands chosen for cotton cultivation, wherever obtainable, were those of a soft deep mold in which the color was darkened by an admixture of decaying vegetable matter, a medium between spongy and sandy soil. These lands were generally found on creek and river bottoms. Now, under improved methods of farming, most any land in the cotton belt that contains the necessary ingredients in an available form, and is well drained, can be made to produce excellent grades of cotton. The loose, sandy soils of the coast regions, that were formerly thought to be unfit for profitable cotton culture, are now producing well under modern treatment."

If a long stapled upland cotton is to be depended on, to any great amount, so far as experience thus far shows, it will have to be the growth of the bottom lands of the Mississippi River and its tributaries. We have from there, already, a comparatively good supply, perhaps exceeding in quantity the Sea Island crop. The Allen and Peeler varieties are the more familiar ones, but their names have become almost generic and refer to a class of upland cotton with a length of staple of 1¼ inches or more. The Allen was originally a cross between the Sea Island and an upland. There are other varieties as the Johnson and the Cook. None of them is as prolific in yield of lint as the common short-stapled cotton, either per acre or per pound of seed cotton.

Aside from our own Sea Islands and contiguous territory, the most interesting region, from which a supply of long-stapled cotton can be obtained, is the valley of the Nile, Egypt. Its

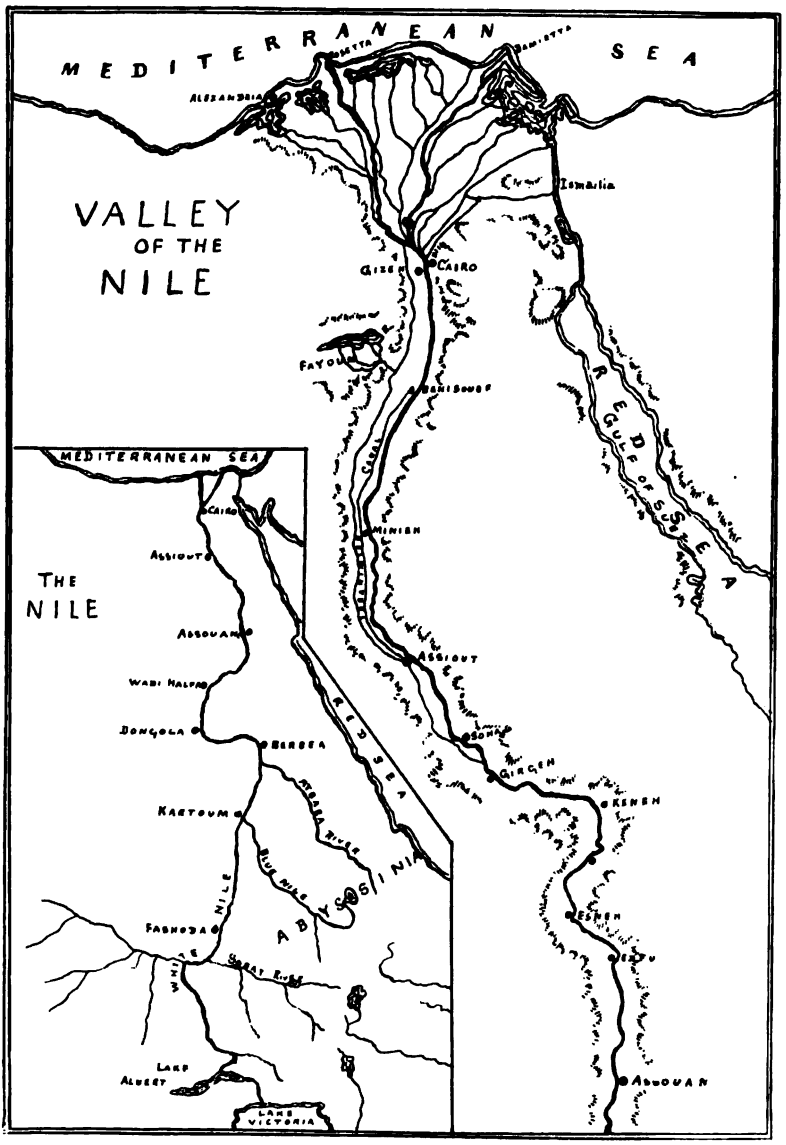

FIGURE 3. — VALLEY OF THE NILE.

FIGURE 4.—BIRD'S EYE VIEW OF THE NILE VALLEY FROM THE ASSOUAN DAM TO THE SEA.

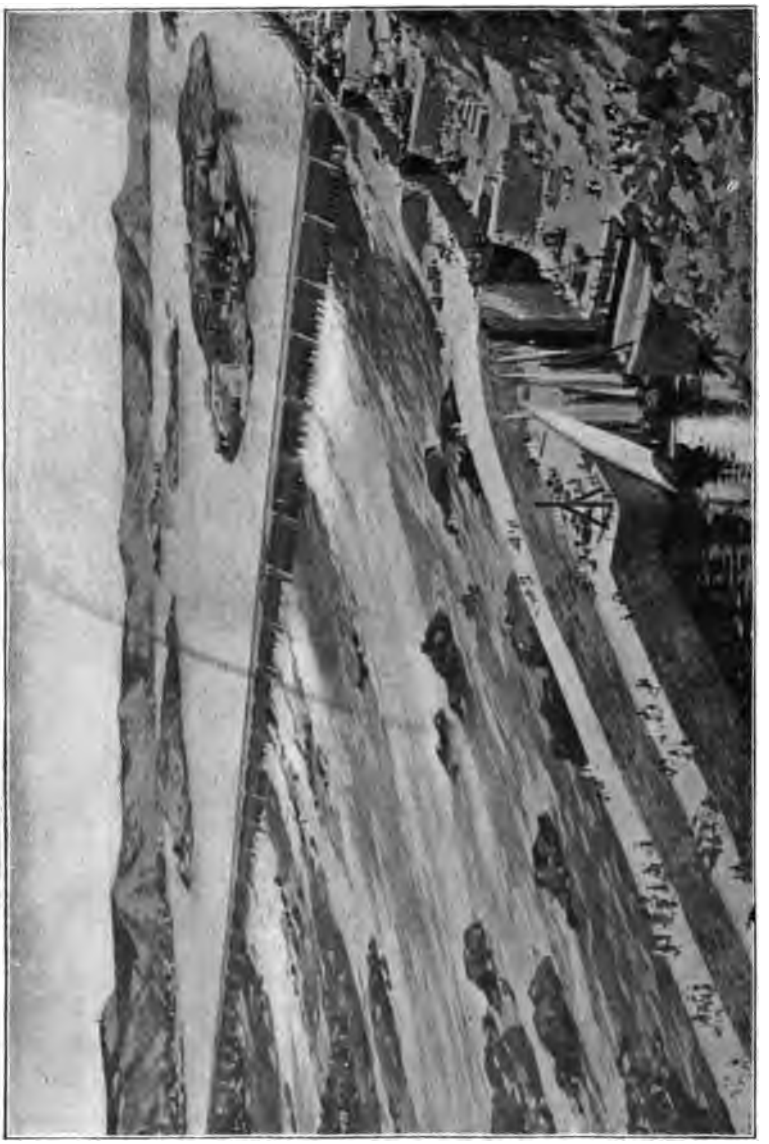

FIGURE 5.— THE GREAT ASSOUAN DAM, SHOWING THE SERIES OF LOCKS BY WHICH VESSELS ASCEND AND DESCEND THE STREAM.

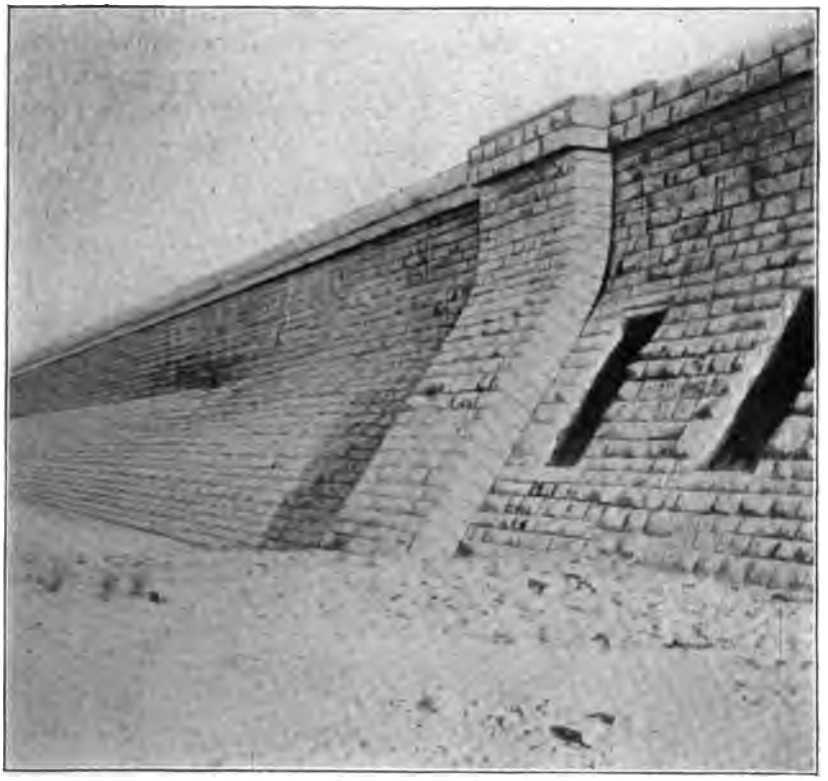

FIGURE 6.—WALL OF THE ASSOUAN DAM.

climate and soil have proven to be peculiarly suitable for the growth of this class of cotton. Lack of rainfall in the parts where the cultivation is carried on, is made up from the overflow and the irrigation system of the Nile which receives its supply of water from the lakes and streams in the rainy districts of interior Africa. The interest in this region is more intensified by the recent completion of the dam across the Nile at Assouan, for an immense reservoir to regulate the supply of water for irrigation purposes, throughout a narrow valley of more than 650 miles long. The agricultural possibilities of this valley are now better

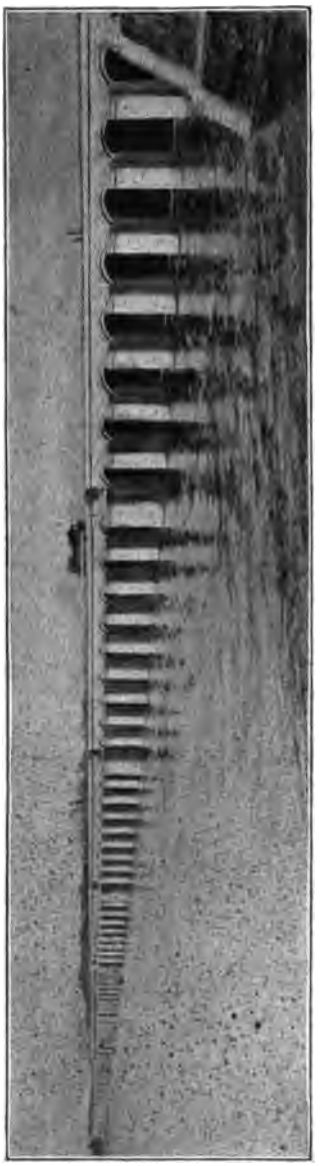

FIGURE 7.—THE ASSIOUT DAM AS IT NOW APPEARS.

assured, and regularity of crops from year to year made more certain. The cotton crop will be benefited with all others, but more than a twenty-five per cent. increase is not expected. This is the estimated effect on the production of long stapled cotton by United States Consul JOHN G. LONG, Cairo. It is not intended to raise short stapled cotton. This amount of increase might be sufficient to keep 5,000,000 more spindles in operation, at the present rate of consumption; a not very great matter for the probable needs of the cotton manufacturing industry not many years hence. From the first cataract, at Assouan, to a few miles north of Cairo, the valley of the Nile is a narrow strip of land, with a maximum width hardly exceeding 15½ miles, and a mean width of about 8 miles. The surveyed area of this part of Egypt is about 2,500,000 acres or about a tenth of the area devoted to cotton planting in the United States. The valley is enclosed on both sides, between arid and desert plateaux, which extend on one hand to the Red Sea and on the other hand into the Great Sahara. It is an elongated oasis. The Delta proper, north of Cairo, is between two branches of the Nile, — the

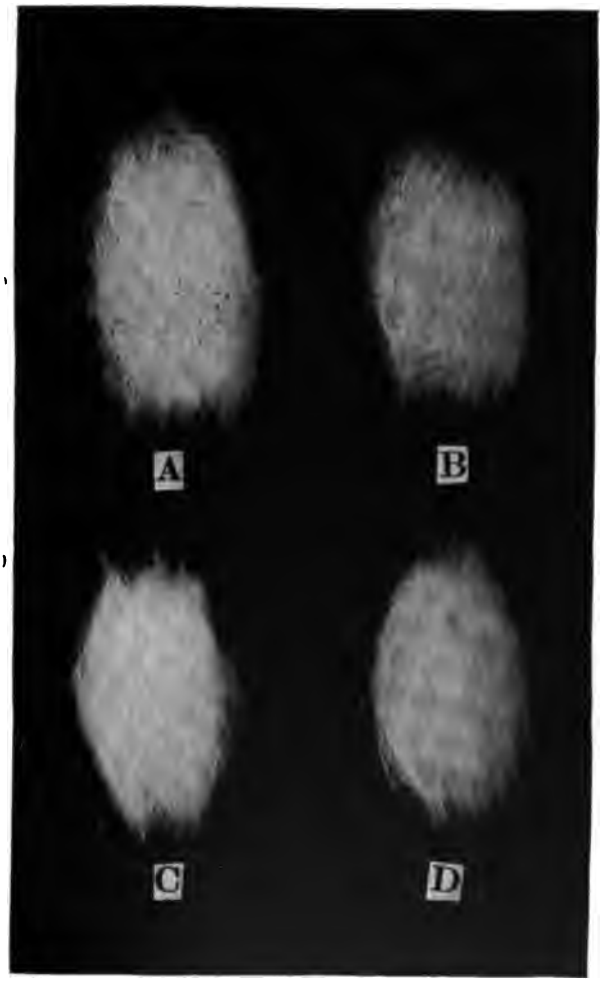

FIGURE 8.— EGYPTIAN COTTON — FULL SIZE.

A — Yannovitch.
B — Mitafifi.
C — Abassi.
D — Ashmouni.

Damietta and the Rosetta — covering an area of 1,800,000 acres. There are areas west of the Rosetta and east of the Damietta of about 1,700,000 acres, making altogether 6,000,000 acres. The area of the entire country, however, including uncultivated land, lakes, marshes, etc., is estimated at a little over 7,000,000 acres.

According to the valuable and recently published work on "Egyptian Irrigation" by WILLIAM WILLCOCKS, there are 5,750,000 acres of cultivable land in Egypt, 2,320,000 acres which lie in Upper Egypt, or south of Cairo, and 3,430,000 acres in Lower Egypt, or north of Cairo. In addition to the 3,430,000 acres in Lower Egypt there are some 500,000 acres of salt and marshy land, of which there has been no attempt at reclamation, though capable of such. At the present time, 4,020,000 acres are under perennial irrigation, and 1,730,000 under flood irrigation. All of the latter are in Upper Egypt. There are, also, in Upper Egypt, 590,000 acres under perennial irrigation, while in Lower Egypt there are 3,430,000 acres under this system of irrigation. If the 1,730,000 acres under flood irrigation were changed into perennial irrigation their gross yield in the value of crops, in the opinion of Mr. WILLCOCKS, would be increased more than one-fifth. It is this change that it is intended to effect by the reservoir at Assouan. Perennial irrigation, it may be stated, is that from canals that run the whole year round, and flood irrigation is that which is performed by canals running only in flood time.

The lowest level water ever reaches at Assouan is 279 feet above the Mediterranean. By means of the recently completed dam the water will be raised to 348 feet above the same level. Sir WILLIAM GARSTIN estimates the volume of water capable of thus being stored at nearly 38,000 million cubic feet, which estimate in Lord CROMER'S opinion, is much below the mark, but it is accepted as a conservative one. Under a proper system of distribution it is calculated that this amount of water will irrigate 70,000 acres in summer, by means of pumping machinery erected on the Nile banks, in Upper Egypt, south of Assiout.

This is reckoned in accordance with Mr. GARSTIN'S rule in all irrigation projects, that of the total area commanded by a canal or pumping station, only one-third can be advantageously cultivated in any one season, as this limit permits of the rotation of crops, and prevents the land becoming exhausted by over-cropping. In this instance it means the perennial irrigation of 210,000 acres. In middle Egypt, from Assiout to Cairo, the increased supply of water will enable an area of 458,000 acres, now irrigated as basins, to be converted into a system of perennial irrigation; and in addition thereto an area of 52,000 acres in the Fayoum, at present uncultivated. In Lower Egypt, north of Cairo, an area of uncultivated land, amounting to 120,000 acres, will be reclaimed, besides insuring the cotton crop against drought. The yield of all crops will be increased. In the Ghizeh Province, 106,000 acres of basin will be converted into perennially irrigated land. Aside from the advantages of bringing more land under cultivation and increasing its productiveness, the insurance against drought is, in itself, a desideratum worth the cost of the Assouan reservoir.

In connection with the system of irrigation it should be understood whence the supply of water comes. The annual rainfall about the lakes of Victoria and Albert is about 55 inches, and the same relates to that above the Sobat, Blue Nile and Atbara rivers in Abyssinia. These rivers are the ruling factors in flood, and the White Nile is the ruling factor during the remainder of the year. The Nile is annually in flood during the months of August, September, October and November. The maximum rainy periods in the lake regions are in April and October. The maximum rainy period of the Sobat is in August, and that of the Blue Nile and Atbara in the same month. August is the great centre of heavy rainfall except in the great lake regions. The heavy rains of Abyssinia cover a period of nearly five months, or from the middle of April to September. The effect of these rainfalls is felt through the valley of the Nile during the fall months. Cotton is not a flood crop, but, purely, a summer crop (April to July, both inclusive)

to which is devoted 110,000 acres in Upper Egypt, and 1,500,000 acres in Lower Egypt, or altogether, 1,610,000 acres for a production of about 600,000,000 pounds of cotton. The area devoted to all kinds of summer crops is said to be 2,050,000 acres. There are different systems for the rotation of crops, and accounts of them are more theoretical than actual. The actual rotation of crops is much after the following fashion:

In the rich lands:

1st year, clover in the winter and cotton in the summer.

2d " beans or wheat in the winter and Indian corn in the summer.

In the poor lands:

1st year, clover in the winter and cotton in the summer.

2d " " " " " " " "

3d " barley " " " rice or fallow in the summer.

What changes will be effected in the systems of crop cultivation by the construction of the Assouan reservoir are yet to be determined, but they may amount to making the cotton crop an annual one instead of every other year or two years out of three. That there will be a very considerable increase in the annual production due to an increase in the cultivated area and more frequent planting of the same land, admits of no question; but the opinion of good judges seems to be that this increase will be not over 25 per cent., for the experience of the past has shown that cotton is not the most profitable crop, and that, for example, fruits and vegetables are more remunerative, and the same may be said, only to a less extent, of rice.*

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* The following is a recent communication received from FRED. FLETCHER, School of Agriculture, Ghizeh, Egypt, through the United States Department of Agriculture:

Cotton is cultivated in Egypt wherever water can be obtained perennially, that is, in the Delta, along the Ibrahimieh Canal, and in the Fayoum.

Varieties are: Mitafifi, Yannovitch, Bamia, Ashmouni, Abassi, Taffiri, Hamouli, South Sea Island, Abiad, (or Tiftawi).

Mitafifi is the first cotton of Egypt, and constitutes a high percentage, about 75 per cent. of the total quantity grown. Grown especially in the Delta. The plant is very hardy, normal in size, small in many parts of the Delta, but not quite so early to

Assuming that the Egyptian cotton crop will be increased 25 per cent. by irrigation from the Assouan reservoir, and taking the average yearly production for the last three seasons at little over 600,000,000 pounds, we have a prospective supply of 750,000,000 pounds. Add this to a possible yield of 40,000,000 pounds of American Sea Island cotton, and we have 790,000,000 pounds of long stapled cotton from the principal countries of present yield for fine spinning. The inland cotton fields of the

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mature as Hamouli, Ashmouni and Abassi. Fibre is yellowish brown and long, is strong and fine to the touch.

Yannovitch is a recently improved variety. Report says selected from Mitafifi. Fibre is longer than that of Mitafifi but lately has deteriorated. Yield about the same as Mitafifi. Fibre whiter. Only grown in favored situations.

Bamia once much grown in Lower Egypt, coming next to Mitafifi. Discovered by a Copt, 1873, possibly obtained by crossing Hibiscus Esculentus (Bamia), with cotton. Tree is larger and coarser in growth than others and requires more water. Fibre is poor compared with Mitafifi and Abassi. Light brown in color and not very strong, shorter and thicker than Mitafifi.

Ashmouni once largely grown, now almost confined to upper Egypt in other words along Ibrahimieh Canal and in Fayoum. Sown earlier than rest as it requires warmer weather for maturing the boll. Plant smaller than other varieties and yields less.

Abassi like Yannovitch is recent. Plant smaller than Mitafifi. Like Ashmouni requires warm weather for last two months. In some districts yields more than Mitafifi. Fibre is white and of long silky texture not as strong as Mitafifi or Yannovitch.

Taffiri is obtained by selection from Mitafifi which it greatly resembles. Not much grown. Yield less than Mitafifi though fibre is more valuable. Fibre is nearly white and fairly strong and in length comes between Mitafifi and Abassi.

Hamouli is not much grown though yield is good and early. Fibre short but fairly strong. Color is pale yellowish white.

Sea Island is extinct here.

Abiad or Tiftawi is supposed to be of Indian origin. Good yield of fair fibre. No demand.

Preparation of Land. This must commence early in February. The land is ploughed as many as nine times with the native plough; two with the European ploughs is sufficient if each is followed by a roller. If the land be very heavy a native ploughing may be interpolated between each European ploughing and the following rolling. After the rolling, the land is thrown into ridges 90 centimeters apart and often left thus for 15 days. The rows should run east and west.

Sowing. Should be from the 1st to 15th of March in south of Delta, 20 to 30 days later in north of Delta. There are two systems of sowing used in Egypt: (1) the "wet method" and (2) the "dry method." In the former the water is run between the ridges eight days before sowing. Seeds previously soaked from 15 to 24

Southern States, especially those in the valleys of the Mississippi River and tributaries, may be calculated upon to furnish 100,000,000 pounds more, which would give a grand total of 890,000,000 pounds for spinning fine or high class yarns. At the present rate of comsumption, based on that of the fine mills of Great Britain, this amount of cotton would require about 24,000,000 spindles, or little over 6,000,000 more spindles than are now in operation on this class of work; which will soon be in demand even under existing trade conditions, at present prices.

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hours in water. This method is suited for heavy land. In the "dry method" the seed (not soaked) is sown in the dry ridges and the land is immediately irrigated. The actual method of sowing is the same in each case, the seed being "dibbled" by children and covered to a depth of 5 to 10 centimeters on the southern side of the ridges. The distance between the holes is 30 to 50 centimeters and 7 to 10 seeds are put in each.

(1) *Wet Method.* This is not the one generally practiced, though it is the best. Reason for not being much used, is, that land must be ploughed early to be able to plant at right time. The seeds are soaked for 15 to 24 hours in water before sowing. Thinning takes place 35 to 45 days after sowing, two of the most vigorous plants being left in each hole. Three to eight days after thinning the first water is given. The other waterings are given at intervals of 12 to 15 days according to rapidity with which the land becomes dry. After each of the first five waterings, the land is hoed to remove weeds and prevent evaporation. In this operation, soil is scraped from the north side of one ridge on to the south side of its neighbor and among the young cotton plants which after a time thus appear in the middle of each ridge. Seven or nine waterings are given before the first picking (early in September) is taken.

(2) *Dry Method.* The second watering is given as soon as the land appears to need it, generally 15 to 20 days after the first, but sometimes, especially in cold weather, 25 to 40 days. The third watering is given 20 to 25 days after this and the rest at intervals of 12 to 20 days. Eight or nine waterings are given before first picking, on the average.

Manuring. Nitrogen supplied by berseem (clover) as a rule. Farm yard manure may be supplied at the rate of 5 centimeters per feddan (1.03 acres). (1) Before ploughing, (2) before ridging, (3) after sowing. A better manure consists of the remains of old tillage. This may be applied at the rate of as much as 40 or 50 centimeters.' Phosphates are the most important artificials used, though potash in some parts improves the quality if not the quantity.

Picking. Three pickings generally obtain. In south of Delta first commences on 30th of August, in north of Delta 30 days later, as a rule. The second picking commences a month after the first, and the third 20 to 30 days later. The first picking should give 50 per cent. of total yield, and the best and cleanest fibre.

Yield. Average three kantars, in good districts seven to eight are obtained per feddan.

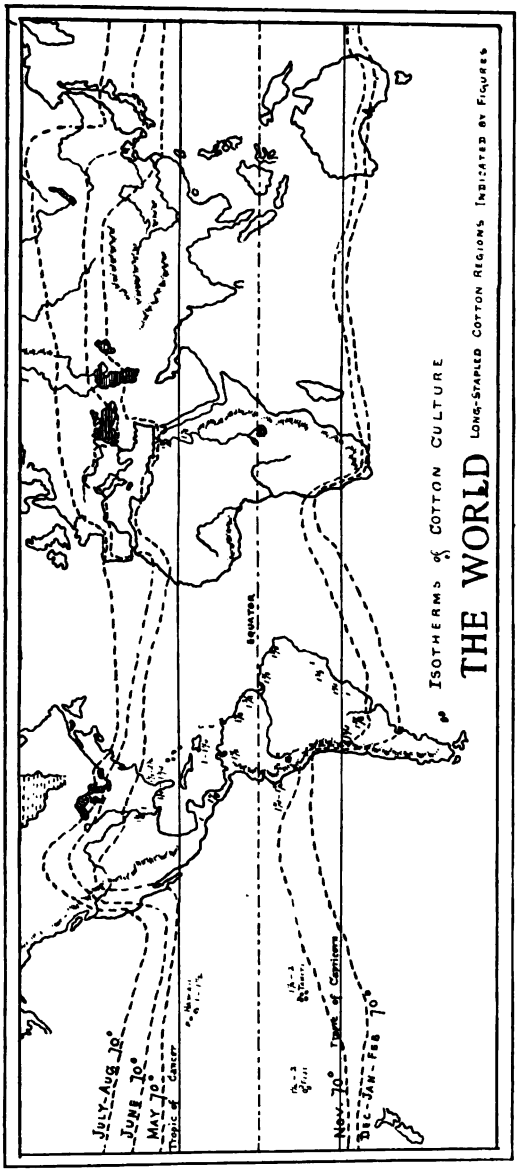

FIGURE 9.—ZONE OF COTTON CULTURE.

The cotton spinners of the world may, sometime, have to study the possibilities of other countries than the United States and Egypt for a supply of long stapled cotton suitable for fine spinning. As I have already said, all long stapled cotton is not suitable for fine spinning. Fineness of fibre is a factor of vital importance. The places where its growth may be expected under proper culture are where it is already produced in some quantity. These places must necessarily be within the isothermal lines of cotton culture, which are those of May, north of the equator, and of November, south of the equator. The climates of countries, north and south of the equator, are greatly affected by the arctic and equatorial currents of the oceans and by the trade winds. Consultation of the accompanying map of the world will show where long stapled cotton is now grown, and also the northern and southern limits of its zone of production.

As is well known, the regions for popular exploitation for an increased cultivation of cotton are in Africa. This is due to the fact that they furnish a better opportunity for freedom of action on the part of the cotton manufacturing countries of Europe, than can be expected in South America because of political reasons. But all movements in this direction in Africa, outside of Egypt, are for increasing the production of cotton without reference to staple, so long as it compares well with the ordinary American upland variety. There is nothing yet determined concerning the capabilities of Africa for the cultivation of cotton on a large and remunerative scale. All experimental efforts, however promising, are yet problematical. Except on the west coast of Africa about the Guinea coast, the annual rainfall is too meagre to offer any substantial expectation of cotton culture ever becoming a matter of considerable moment. It is too early and unsafe to predict the agricultural possibilities of the African continent. It contains too many doubtful quantities. What there is in the Congo River valleys for the production of cotton is unknown. The rainfall there may be sufficient, the soil is undoubtedly rich with accumulations of ages, but the climate is trying upon the constitution of Europeans. Rainfall, its dis-

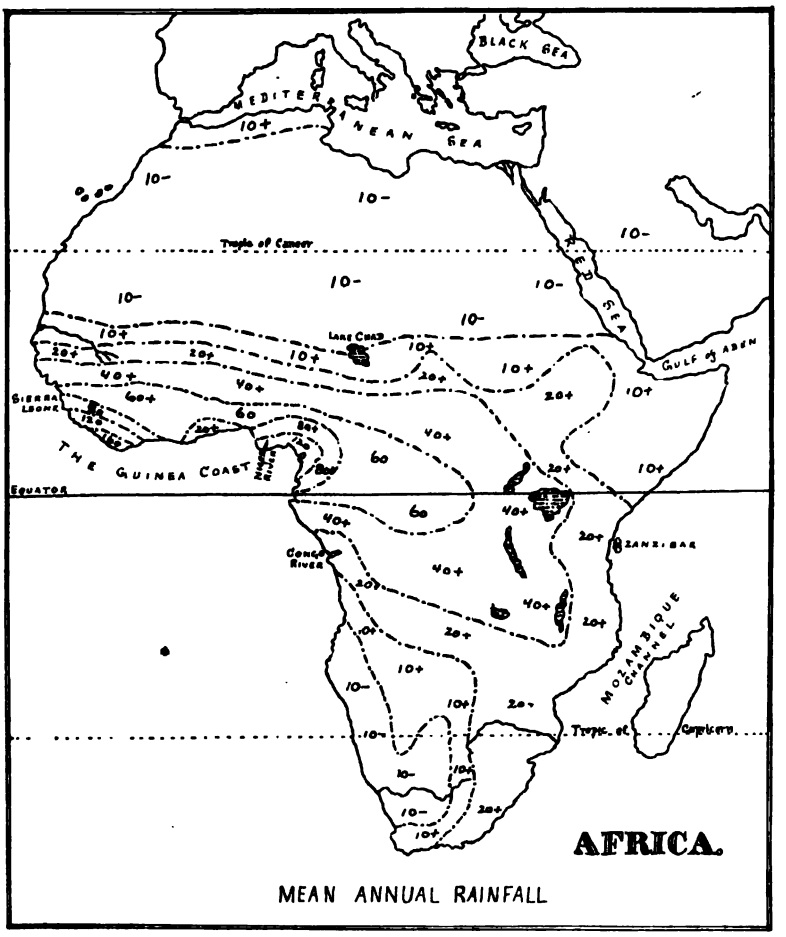

FIGURE 10.—AFRICA.

The figures show the Mean Annual Rainfall in inches.

tribution during the seasons, seasonal temperatures, character of soil, relative humidity, have all to be taken into account, and observations on these points have not extended over a sufficient period of time and carried to a completeness enough to furnish reliable data upon which to form definite conclusions.

FIGURE 11.—WEST AFRICA.

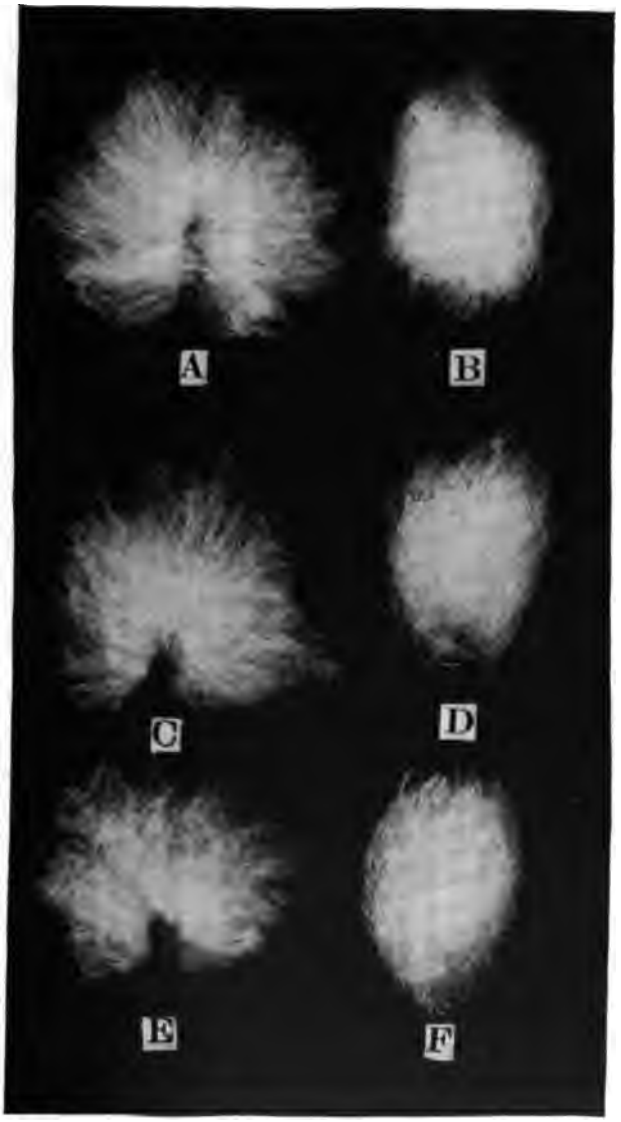

FIGURE 12.— COTTON GROWN IN TOGOLAND, AFRICA, IN 1900 AND 1901.

A, *B*, *C*, *D*. From Alabama Seed cultivated by negroes from the Tuskegee Institute, and employed by the German government.

E, *F*.— Native Cotton cultivated by Tuskegee Institute negroes.

Something is being done in German Togoland, but it is altogether tentative thus far, and if a production can be depended on of a quality equal to the American upland, it is probably all that can be hoped for. Specimens of cotton that has been grown there from American seed, under the encourgement of the German government and supervision of intelligent negro labor imported from Alabama, show the possibilities of the region for the production of good stapled cotton compared with the average of that raised in the Carolina States. Even some of the native cotton seems to be of a fairly good quality. The cotton manfacturing industry of Great Britain is, also, earnestly studying the opportunities of the west coast of Africa, from the Senegal river to the equator, for the successful cultivation of cotton, which can now be better carried on under more promising conditions than was the case forty years ago, when efforts were made in this direction and afterwards abandoned. Nothing, however, has given evidence of the possibilities in the way of growing long stapled cotton in this region. Thus far the natural tendency seems to be degeneracy rather than improvement in the length of staple of cotton grown there, and that to keep it up fresh importations of seed have to be made from the United States. When there is a disposition on the part of cotton to deteriorate in length of staple or fineness of fibre below a certain standard suitable for fine spinning, the conditions are unfavorable for any promising production of long stapled cotton. For the purposes of this paper the continent of Africa, outside of the Nile district, may be unconsidered.

South America has given better evidence of producing, under natural conditions, long stapled cotton than anywhere else, except the United States and Egypt. The annual and seasonal rainfall appears to be favorable to cotton cultivation, north of the equator, and through the central parts, and along the eastern coast, except in spots, north of the Rio de la Plata. The rainfall and temperature seem to be good within the isothermal limits of cotton culture. On the west coast, south of Lima, Peru, cotton growing is an uncertain occupation. There is a deficiency

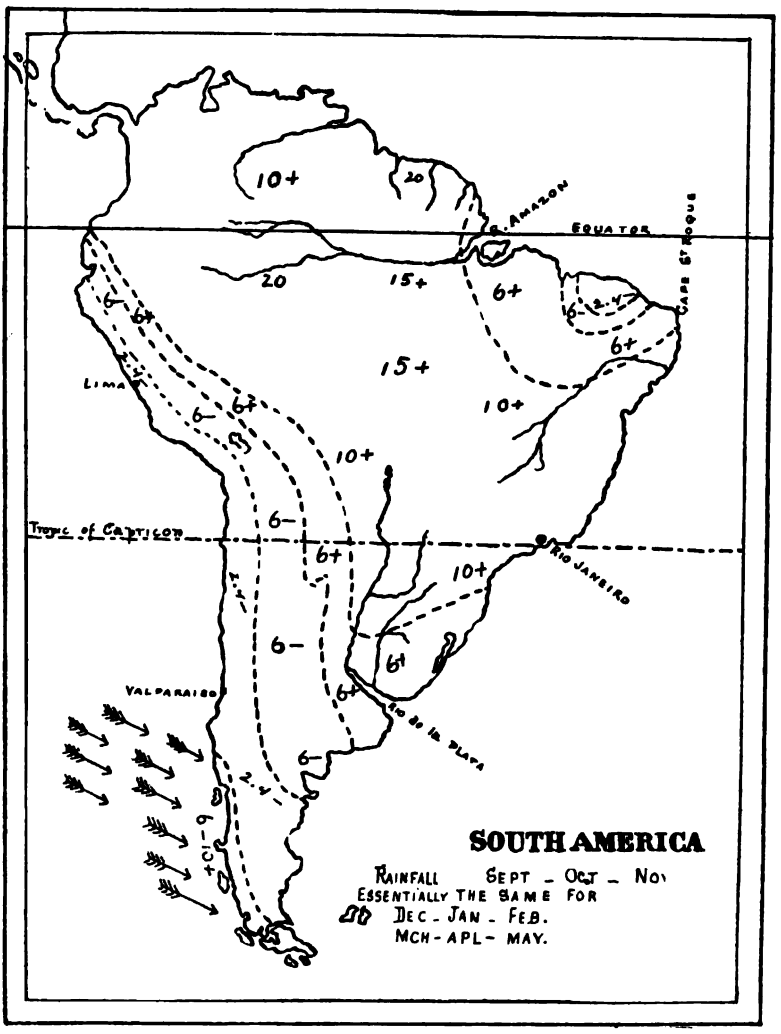

FIGURE 13.—SOUTH AMERICA.

Three Months' rainfall, expressed in inches.

of rainfall and the temperature is not of the right kind. The latter is affected by the Arctic oceanic current that runs up along the west coast that causes all isotherms to bend northward.

The long stapled cotton of Piura, Peru, is familiar to all cotton spinners and to not a few woolen manufacturers, who find it peculiarly adapted to mixing with wool; but it is not a favorite for spinning fine yarns — its nature is not adapted to them. Some good lengthed cotton comes from different parts of Brazil and Guiana. It is to be found among the different islands of the West Indies. In all of these localities it has had a natural growth; and in my opinion, its future, if anywhere, is to be found in some one or more of these. But wherever its future may be, much has to be done towards its cultivation to bring it to a proper standard for fine spinning.

The PRESIDENT. Gentlemen, you have heard Mr. KITTREDGE'S paper. Are there any questions to be asked with reference to this?

Mr. JAMES R. MACCOLL. This is a very interesting paper, especially to the users of long staple cotton, and will form a valuable addition to our Transactions, and I desire to express my appreciation of the care with which it has been prepared. Those of us who use long staple cottons, know that the production of them has been entirely used up for the last few years. It has been a generally accepted axiom that it is a good plan to buy long staple cottons early in the season, because there are none to be obtained later, and this has been emphasized more and more, I think, each recent year. The reasons are apparent. A greatly increased production of fine yarns, the employment of combs to a much larger extent, and the process of mercerizing, have all

been important factors. In order to get satisfactory results in mercerizing, combed yarns made of long stapled cotton are generally used, and even coarse counts of mercerized yarns are made from the same class of cottons. We must therefore expect, I think, to see a shortage, and almost a famine, of long stapled cottons, unless there is a greatly increased production within a few years. It suggests to us all, the policy of looking out for our supplies of this kind of cotton.

Mr. J. D. AIKEN. In considering a possible shortage in the supply of long staple cottons we naturally look for a cause that might bring about such a result, and in this instance we find it without looking.

The growth and development of the cotton manufacturing industry in the South has much to do with the increase in fine spinning outside of that section.

Next to the competition of the South, it seems that the resurrection and ascension of the process of mercerizing may be considered the most potent factor in the increasing demand for combed and finer yarns made from these cottons.

It would seem, however, that the invention and perfection of machines for the combing of the shorter staple cottons might render it no longer necessary to incorporate long cotton into coarse yarns and in this way relieve the situation somewhat.

All the European governments that possess any territory upon which cotton might be grown appear to be making great effort at the present time to add to the world's supply of cotton, and to view with alarm the quantity which has been subtracted from this supply by consumption in our southern mills. Russia, if no other country, is encouraging the production of cotton to the extent of placing a duty on all imported cotton both raw and manufactured.

Now that our government has undertaken to irrigate the arid West, it may possibly be induced to drain the swampy South and thus reclaim many thousand acres of land suitable for the culture of long staple cottons.

As long cotton cannot be grown, at present, continuously upon the same land, successfully, even with the aid of commercial fertilizer, we may look forward hopefully to the day when the chemists of our Bureau of Soils may discover the secrets of plant food and the vitalizing of lands so that their yielding may be as constant as the seasons and the other elements that lend to its growth; then there will be no worn-out fields and all newly cleared lands will become permanent additions to the production of superior cottons.

The low price of all cottons ten or twelve years ago was instrumental in inducing many planters, especially the class in question, to plant other crops and to go extensively into the growing of garden truck for Northern tables. Notwithstanding this cotton will always be a staple crop in the South.

It has advantages and peculiarities possessed by no other agricultural product in the world. It is practically the same as gold, it is always salable; if carefully stored it may be kept indefinitely, without appreciable depreciation; it is always in demand, and can be sold before it is planted; and yet, when it is harvested, it is of no intrinsic value to the producer in his domestic economy, and, in point of fact, many of its growers are utterly ignorant as to its ultimate manipulation and purpose.

Like other products of human ingenuity and labor it responds to attention and devotion.

It is recorded that the seed was first obtained from the West Indies in 1788, and that it was brought to its present state of perfection through the favorable influences of soil and climate, fertilization and tillage, and the careful selection of seed, each year, in the breeding-up process.

And although Sea Island cotton, which is the parent of all long staple cottons, had reached a high stage of development in 1860, yet, at planting time in 1865, it has been told me that there was not a pint of this seed to be had in the South, thus necessitating its most careful nursing and rearing for a second time, to its present recognized superiority over all others.

It may be well to remember that long stapled cotton is the

"registered," "fancy" or "blooded stock" of the cotton plantation, and that even this better cotton, in itself, is of no individual use to the grower, and that in every instance where he is sufficiently intelligent and interested to attempt to produce a high grade of fibre, he is likewise sufficiently interested and intelligent to know that when the market price falls below the cost of production, it fails in its sole purpose as a ready-money crop and should not be planted.

In Egypt, where the English government owns and controls the extensive and dependent system of irrigation, it may be possible under certain conditions to refuse to rent or supply water in some cases except for the growing of cotton, and in this way exert a decided influence upon its cultivation; but in our country, at present, its growth can only be encouraged and expanded by the promise of a fair reward in dollars and cents to the man behind the industry, as there is no other element lacking.

The PRESIDENT. Gentlemen, we are unusually favored by the presence of General WILLIAM F. DRAPER, who is ready to give us the latest points on the Northrop Loom. [Applause.]

General WILLIAM F. DRAPER. Mr. President and gentlemen of the convention: I am requested to read a paper today on The Continued Development of the Northrop Loom. Your Secretary has asked me two or three times to read a similar paper, but I have either been called away or there was some particular invention that we were at work upon in connection with the loom which I thought might be perfected, so it was well to put it off, and this is the first time that I have been able to respond to his request.

*CONTINUED DEVELOPMENT OF THE NORTHROP LOOM.

GEN. WILLIAM F. DRAPER, Hopedale, Mass.

In speaking of the Northrop loom I am tempted to an enthusiasm which does not accord with my nature, as, if I know myself, I am practical rather than imaginative. This particular invention, however, or series of inventions, has so much of my life *woven* into it that I may, to some extent, speak from the heart rather than the head.

The loom is founded on the bottom inventions of JAMES H. NORTHROP, a heaven born mechanical genius, but it has also embodied in it the result of the thought and experiment of many other able men, and all, or substantially all, of the creation of the machine has been done under my personal eye and subjected to my personal criticism and change before it has been commercially adopted. I have spent years over it, searching for defects in operation, finding exactly what caused them, and then, personally and through our corps of inventors, endeavoring to overcome them. I have thought of it days and dreamed of it nights, and continue to do so, in addition to the time spent in our weaving and experiment rooms.

No work of my life, which has been somewhat varied, has been more interesting; none will probably be as valuable after I have passed on. The profit that I have derived or hope to derive from it, is a side issue as compared with the success being

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* For further reference on this subject see Transactions as follows: Vol. 59, p. 88, GEORGE OTIS DRAPER, Present Development of the Northrop Loom; Vol. 59, p. 106, WILLIAM J. KENT, The Northrop Loom; Vol. 60, p. 123, FRANK M. MESSENGER, The Northrop Loom; Vol. 60, p. 129, Gen. WILLIAM F. DRAPER, The Northrop Loom; Vol. 62, p. 290, EBEN S. DRAPER, The Northrop Loom on Twilled Goods; Vol. 71, p. 308, WILLIAM WHITTAM, Jr., The Northrop Loom.

attained in doubling, or more than doubling, the productiveness of labor in an old art like weaving, the world over.

Our routine has been, firstly, to run a number of looms experimentally in a room in our shop, and by means of special observers, in addition to the weavers, to note results in detail. These results are collated in daily reports, which are preserved for study and reference. Notes are made of everything outside of perfect weaving, the breakage, wear or slipping of parts, the failure of mechanism to act every time as intended, imperfections in the cloth, like thick or thin places, the number of warp and filling threads broken and why they break, if it can be known. After studying these reports in connection with personal observation of the running looms, changes are made, with a view to improvement if possible. Pieces that break are strengthened, or strains are removed; parts that slip are more securely fastened; and wear is obviated where it seems possible.

New devices are suggested to obviate cloth imperfections, or breakage of warp or filling, of bobbins or shuttles. The new parts are made and tested in comparison with the old ones, and nine times out of ten they don't work as well. Perhaps they don't overcome the difficulty; perhaps in overcoming it they introduce new ones. After one failure comes another attempt, and as a rule another failure, but something is learned from each trial and the general course is towards improvement.

The worst troubles to find and cure are those that are intermittent and infrequent. A device will work as intended a hundred or a thousand times. Then it fails once from some unknown cause; then it goes on all right as before. One seldom or never sees the failure except in result, and if it happens before one's very eyes the motions of the loom are too rapid to make eyesight of much advantage. One can only reason in these cases and, as in some other matters, unassisted reason without sufficient data comes pretty near being a *guess*. However, guess we must or let the defect continue, and in some cases we have guessed right. In others we are still guessing.

After we reach what seems a real improvement on one loom,

we try it on a dozen, more or less, and keep records for a month or two. Here again disappointment often comes in and we return to fresh study and experiment. If, however, the advance proves real, we next arrange a mill test; that is, we fill an order, or a part of an order, for looms with the new device, and submit it to the tender mercies of those who have to run it practically and without any special interest beyond "day-pay and Saturday night".

This kills many an infant invention that would be of value if properly cared for. No new device in minor detail can succeed in the mill if it causes extra trouble, even if it does better work; and if any new adjustments are introduced, they are almost sure to introduce wrong setting. Lack of adjustment induces filing and chipping to attain positions that our experiments have shown to be wrong, but the fixers have not been through the experimenting and sometimes want to make improvements themselves. Cams that have been carefully worked out have been filed or ground so that they would not work as intended and the device has been condemned, and in more than one instance operating parts have been cut off with a cold chisel and the new device pronounced valueless.

After this experience we re-design, simplify and try to make the new arrangement easier to run than the old, and if we succeed and accomplish the original design, we have made a step forward.

It is fair to say that from these mill tests we often get ideas of great practical value from intelligent operators, who see necessities that had not occurred to us, more than enough, perhaps, to offset the stupid condemnation of others who do not appreciate fine points and never will until they have become a part of their regular drill, and only then because if *they* can't make a machine run, there are plenty of others who know how to do it.

Though we are not through yet, the result to date is eminently satisfactory, we having produced the most important advance in weaving since the invention of the power loom, an advance which cannot be measured by dollars, but measured in

that way by Ex-Governor LIPPITT of Rhode Island, would roughly equal for this country in annual saving the interest on the national debt when the loom is universally adopted.

The original problem was a difficult one to accomplish — the automatic and practical changing of filling without stopping the loom — which relieved the weaver of more than half his labor and enables him to run more than twice as many looms on any style of fabrics to which the Northrop principle has yet been applied. Some sixty inventors had worked in this direction before we began. Some of them spent fortunes unsuccessfully; one or two even, are said to have lost their minds in the attempt to solve the, for them, insolvable problem. Their failures, and the failures of those who have endeavored to imitate us since, as nearly as our patent claims will allow, have shown the difficulty of attaining the result that we have attained.

I have been surprised in looking over the records of this Association to learn that seven years have elapsed since any representative of our company has discussed the Northrop loom before you. At the meeting October 25, 1895, at Atlanta, my son, Mr. GEORGE OTIS DRAPER, read a carefully prepared paper on this subject, and in April, 1896, I was called on unexpectedly to state the results of our experience with the new machine up to that date. Since then we have not called your attention to the progress of this wonderful invention, but our machine has been advertising itself in your mills in ever increasing numbers.

In my remarks in 1896 I find that I said that we had shipped about 6,000 looms and had 3,500 under order. On the first of January, 1903, the number of our shipments and unfilled orders exceeded 80,000, or about 20 per cent. of the looms in this country to which filling changing attachments are applicable. Two hundred and ten different concerns have the loom in use or ordered; 123 have over 100 each; 51 over 500 each; and 21 over 1,000 each. Among the concerns who have them in large use are the Grosvenor Dale Co., the Amoskeag Co., the Lonsdale Co., the Pacific Mills, the Queen City Cotton Co., the Tremont & Suffolk Mills, the Massachusetts Cotton Mills, the

Lockwood Co., the Boott Cotton Mills, and the United States Cotton Co., at the North; and the Pelzer, the Gaffney, the Olympia, the Granby, the Pacolet, the Spartan, and the Tucapau at the South.

Mills that order once, continue their orders, and we consider it only a question of time, and not of long time, either, when all our mills will be as thoroughly equipped with Northrop looms as they now are with the rapidly running spindles that our company has introduced. This will assuredly be the case unless some machine clearly better than the Northrop is invented and and introduced. Something not as good as the Northrop, though better than the old loom, will not meet your requirements, gentlemen, and no amount of plausible talk about untried new inventions will offset the practical results that we have attained on such a large scale. We are now producing 2,000 looms a month and failing to keep up with our accumulating orders at that.

The stage of preliminary introduction is past. We are now where manufacturers generally feel that in ordering new looms they must have the Northrop, or do worse, and we shall soon reach the point where manufacturers who desire to do a profitable business will feel the need of having as good tools as their competitors who use our loom.

In 1896, when I addressed you informally, the loom was working practically, as far as its special features are concerned. We wrote about that date in one of our circulars:

"This improved loom carries a supply of fourteen bobbins of filling in a hopper, which number could easily be increased. The weaver is therefore relieved of thirteen or more journeys to the loom that would have formerly been necessary. A very important point, also, from a humanitarian standpoint, is the fact that this loom relieves the weaver from the unhealthy act of sucking the filling through the eye of the shuttle and injuring the lungs through the cotton fibre inhaled. When it is realized that this act is performed about 200,000 times per year by each

operative, it is no cause for wonder that weavers as a class are proverbially short-lived and consumptive.

"Involved in this apparatus are devices that permit the shuttle to vary in position to a certain extent, as it necessarily does in practice, and yet prevent any damage if the shuttle should be abnormally displaced. It is also arranged so that the loom will stop automatically should the hopper become exhausted or should the shuttle eye become clogged so that it refuses to be threaded.

"We have also combined with the filling-changer a warp-stop-motion device that instantly stops the loom when a warp thread breaks. This combination relieves the weaver of all responsibility.

"Warp-stop-motions are old in theory but undeveloped in practice, as before the filling changer was invented there was slight necessity for their use, the weaver necessarily being near a few looms all the time where oversight was easy. General DRAPER conceived the idea of combining a warp-stop-motion with the Northrop device, and the present mechanism has been most skillfully devised by another Hopedale inventor, Mr. CHARLES F. ROPER. There are several kinds of stop motions developed for different uses, the one here referred to being made a part of the harness mechanism, each heddle serving as a drop wire to detect on the instant any severing of a warp thread.

"It is easy to figure out the saving that this loom will introduce. If less than half the weavers are necessary, the labor cost is of course greatly reduced. As the labor cost of weaving will probably average about one-half of the entire labor cost in the mill, it seems that the value of this invention is simply enormous."

Our experience up to 1896, on a comparatively narrow scale, has been fully confirmed since on a large scale. Weavers run twice as many Northrop as common looms and in many cases more; and more than this, their work is easier and requires less skill, as the loom works automatically in several directions where special watchfulness and care are necessary on

the common loom. The loom, moreover, has been improved since 1896 in various features, to the most important of which I will refer. The process is still going on and will continue until in our view it is impossible to make a better weaving machine in any single particular.

We do not, however, advise any one to wait for further improvements. The Northrop is now far ahead of any other machine for the purpose, and, as the experience of the past 100 years has shown, the loom, with its peculiar motions required in making cloth, does not lend itself easily to radical changes.

IMPROVEMENTS IN THE HOPPER.

Taking up what we have done, without going into minute detail, we have changed over the hopper, which holds the filling bobbins, in several important particulars. Our first suggestion of a need in this direction came from the Amoskeag Company, who were having trouble with the wear and breakage of bobbins, and suggested a remedy which we adopted with some modifications. We are experimenting still further in this line and expect to eliminate the troubles referred to *entirely* instead of *nearly*, though our present device leaves little more to be desired.

We also found that a capacity for a larger number of bobbins in the hopper made the weaver's work easier, it being necessary for him to visit each loom less frequently; and we have enlarged that capacity from 15 to 24 bobbins, which, on ordinary work, will last in the neighborhood of three hours.

We have also adapted the hopper to cop skewers, so that the loom is not limited to bobbin filling. We are having excellent success with cops, and though there is a little more work for the weaver when they are used, as the cops have to be skewered, the saving is almost as great as with bobbin filling.

THE FEELER.

We have also developed the so-called feeler mechanism, and have sold thousands of looms of which it has formed a part.

Though it has been a success, and though looms fitted with it have made a superior quality of cloth, it has been handicapped by the fact that there is, and must be, a loss of waste on each bobbin thrown out before it is exhausted, and by the further and more serious fact that the amounts thrown out have been uneven and excessive in many cases. Careful study has developed the fact that these variations have been due to two causes: first, the looseness of the crank shaft in its bearings; and second, that an adjustment of the box plate to regulate the pick has required also a resetting of the feeler, which it has not always had.

Mr. AUMANN, agent of the Dwight Co. of Chicopee, has invented a device which we have adopted, which overcomes the first of these troubles, and the author of this paper and his son, CLARE, have, we hope, cured the other, by having the piece carrying the feeler lever contact with the box plate wherever it may be. With these devices neither looseness of the crank arms, nor setting the box plates, affect the operation of the feeler materially, and we expect that the amount of waste will be greatly reduced on looms that we send out hereafter. Further, when once the feeler is properly set, it will not require readjustment unless some of the parts slip or get out of place. We are now shipping feeler looms made on these lines, and getting very favorable results.

We have also arranged to reduce waste by applying a so-called bunch builder to the spinning frame. This winds a narrow bunch on the bobbin, with a warp wind, and then automatically changes to the filling wind and fills the bobbin. In weaving off, the yarn spun with the filling wind is first exhausted, and then the narrow bunch is reduced in size until the feeler operates, and the amount of waste made is but trifling, if the parts are properly set. This bunch builder on the spinning frame is a most desirable adjunct to the feeler system.

The feeler plan of throwing out a bobbin before the yarn on it is exhausted, makes the use of a special thread cutter to cut the thread from the outgoing bobbin near the cloth, necessary. Without this attachment, it may weave into the cloth and cause

a blemish, which would not exist in ordinary weaving. We have spent more time, brains, and money, in perfecting this attachment than any other on the loom outside of the original Northrop invention; and have at last a device that operates perfectly nine times out of ten, and fairly well the tenth time. This makes practically perfect cloth, but we hope to do better yet, as we shall not be content short of its perfect operation *every* time. If any one using our feeler looms sees a way to accomplish the desired result, we shall appreciate his coöperation.

THE STEEL HARNESS SEPARATOR.

On the warp-stop-motion our great advance has been the invention by Mr. C. F. ROPER of a separator for the steel harness, which tends to keep the heddles straight on difficult work, and which makes this most desirable form of harness and stop-motion practical for all kinds of work. A new form of this separator, invented by Mr. JONAS NORTHROP, a brother of the inventor of the filling changer, seems to have merit beyond anything we have yet applied, and we are about sending it out for mill tests. The Roper form is applied every half or three-quarters of an inch across the harness bar, while the new form substantially controls the position of each heddle, without interfering with its capacity for dropping in case of a broken thread.

We have also made the best single thread stop-motion that we have seen, for use with the cotton harness, and have acquired from Messrs. Coldwell & Gildard the exclusive right to use their electric stop-motion for filling changing looms, and the exclusive right to use their devices for any looms in connection with a mechanical stop-motion. We believe that their manner of applying the detector will cause less breakage of warp than any other that has yet been devised, where a stop-motion outside of the harness is used. The steel harness will probably break less threads than any other form, after use has made it perfectly smooth, though it breaks more yarn when first started.

TAKE-UP MOTIONS.

Outside of our special attachments, as said before, we have

felt obliged to give attention to other parts of the loom, and the feature of the ordinary loom which made us the greatest trouble in our earlier sales was the take-up motion. I quote from one of our circulars on this point:

"There is no motion on a loom having a greater effect on the goods than the mechanism which winds the cloth into a suitable roll after the fabric has been formed by the insertion of filling between the warp shades. There are really two motions to this mechanism, one governing the proper movement of the roll, which by its rotation moves the newly formed cloth away from the reed, and the other being that combination of parts which controls the proper winding of the cloth. The latter motion is sometimes referred to as a cut motion. Our experience with these devices has been spread over a wide field, and it may be interesting to follow the evolution from the commencement.

"When we started to build looms the take-up which we adopted was of the so-called Mason style. The cloth passed directly over the breast beam, around a rough-surfaced roll situated about half way between the breast beam and the floor. The movement of this roll was ensured at every other pick by a pawl depending from the vibrator lever governing the filling fork slide, and moved by a cam on the lower shaft. As constructed, this device would properly take two cuts of print cloth, or three by crowding.

"We soon had reason to devise a take-up that would wind a roll of cloth at least eighteen inches in diameter. We found that the construction of certain parts of our loom prevented the adoption of any well known trade device for this purpose, so we were forced to design one of our own, although the principle involved was somewhat common. In order to wind the large roll desired, it was thought necessary to place the rough-surfaced roll down near the floor. An objection at once arose, as the great length of cloth from the reed to this roll introduced chances for wrinkling, stretching and contracting in width.

"We tried to overcome this difficulty by putting a rough-sur-

faced idle roller at the breast beam. This device was not wholly satisfactory, as it could turn in both directions, and therefore did not hold the cloth well. There was also considerable distance between it and the lower roll, allowing the usual chance for contraction and wrinkling. We then substituted a board for this roll to give the necessary friction for the cloth, and this seemed to lessen the difficulty, while the substitution of a metal winding roll for the wooden roll then universally used on American looms, proved a great improvement. A wooden roll is bound to shrink or swell as the atmosphere changes, thereby producing uneven picks in the goods, as the circumference of the winding roll varies from day to day. Cast iron rolls have been used in England for this purpose, but we adopted a light style of iron pipe, an equally unchanging material, and arranged to apply the necessary fillet by having wooden plugs inserted at proper intervals. Since introducing this improvement we have noticed that other American builders are doing something in the same line.

"Having reached this stage we were still confronted by complaints about minor defects in the cloth, especially on our large size take-up, and we decided that it was useless to try to improve on well known mechanisms, when the evident need was for a new principle. We therefore started our inventor, Mr. NORTHROP, at work on an idea never before tried on American looms to our knowledge, and the results have been most encouraging. Starting with the broad idea of holding the cloth as soon after formation as possible, Mr. NORTHROP placed his winding roll where it would engage the cloth almost immediately after the fabric was woven, dispensing entirely with the ordinary breast beam, over which the cloth always went with former devices. To wind the cloth he devised a spring arrangement, which pressed the roll of cloth up against the lower surface of the winding roll. This method was adopted after several experiments with weights and other devices. With the mechanical part of the problem solved, the results soon showed greater advantages than were ever considered possible.

Not only was the cloth wound as made, without wrinkling, but it was found that the width was uniform to an extent never before known. In many mills the old construction produced cloth where the same cut showed a variation of over one inch in width; and where this evil is deemed important second hands are constantly employed in adjusting the looms, performing their duties with a measuring stick as a constant factor. An unlooked for advantage was the discovery of the fact that the roll of cloth was wound much more compactly and more uniform than formerly, where its weight alone determined its compactness. The tension of the spring increases proportionately to the size of the roll, and yet is at any time greater than would be possible by simply depending on the weight of the cloth itself. This enables more cloth to be wound in the same size of roll. This tension can, of course, be graduated to suit requirements.

"Another great advantage is the fact that the loom at the front is open, so that the fixer can get at the harness cams and straps, or any other part of the loom near the front, with greater ease, as there is nothing to obstruct the front of the loom between the breast beam and the girt except the roll of cloth itself, which is of course variable in size, though generally allowing ample space beneath it. The breast beam referred to is different from the usual device for the purpose, in that it passes on the *outside* of the cloth, and thereby protects it from blemish, so often caused by the weaver leaning on the breast beam or rubbing by it.

"Still another expected factor is the marked reduction of warp breakage, probably due to the fact that the cloth does not move back and forth to the usual extent, which prevents the sawing action on the warp. There is also less strain on the temple rolls, as the winding roll itself is of great assistance to the temples.

"One important novelty introduced is the chance for adjustment in the vertical position of the winding roll, thereby allowing a change of angle in the cloth to produce varying effects in the face of the goods.

"Since the first pattern a marked improvement in detail has been made, whereby the winding of the roll of cloth is governed by a single spring instead of two, and the operation of removing the cloth is governed by a simple unwinding method with a crank, the whole apparatus being reduced to its least possible terms.

"Since perfecting this motion we have used it on practically every loom built, though we build other forms when desired and specially ordered. We apply the motion to looms, irrespective of the length of cloth desired on a roll. Of course, it is an advantage in many cases to wind a larger roll. When used for small rolls there is no inconvenience introduced, as the mechanism is independent of such conditions.

"We fully believe that the advantages of this mechanism alone would be sufficient to control the sale of looms where its merits were fully understood, if our loom possessed no other advantage. Considered, however, as an adjunct to our filling charger and warp stop motion, it simply places our loom so much farther ahead, as compared with the ordinary machine."

Nothing more needs to be said, as these take-ups are telling their own story by tens of thousands. At the present time we are simplifying the motion, with a view to saving complication and blacklash; and we have also added a connection which permits the loom to be turned forward or backward by hand when the belt is on the loose pulley, without actuating the take-up mechanism, thereby saving the thin places which generally accompany the mending of a broken warp thread on thin goods. This devise is now awaiting mill tests, it having shown a marked improvement in the thin goods woven in our weaving room, and no disadvantage on the heavier goods. It is needless to say that we are covering the improvement thoroughly by letters patent.

LET-OFF MOTIONS.

Closely allied with the take-up motion is the let-off motion, which delivers yarn from the beam, as it is required to make

cloth of the requisite number of picks. No part of a loom has received more attention from inventors, and nowhere has the exercise of mechanical ingenuity produced so little beneficial result.

The best let-off motion to-day, when properly adjusted, is the so-called friction, which allows the beam to turn and deliver yarn when a certain tension exists, and otherwise prevents its turning. The objection to it is that the size of the beam continually changes, by the unwinding of the yarn, and this change in diameter changes the leverage of the yarn, and makes it harder to turn the beam as it diminishes in size. This increases the tension of the yarn as the beam grows small, and has to be compensated for by a shifting of weights on levers under the control of the weaver. Now, while at proper tension the friction makes more even cloth than any other known device, the tension is continually varying, and is not alike on any two looms; while there is a tendency on the part of many weavers to run with too little tension, and turn down on the take-up gear, thus diminishing the picks and reaching the cut mark sooner, at the expense of the quality of the cloth.

For these reasons mechanical let-offs are preferred by most manufacturers, and the best one of them has been the so-called Bartlett, which, like the friction, is governed by the tension of the yarn, but unlike it, is not allowed to deliver yarn at the beat, that is, while the pick is being driven home.

One great fault with the Bartlett has been the necessity of adjusting the tension as the beam grew small, though this adjustment was outside the province of the weaver. I have endeavored to overcome this difficulty through devices worked out by Mr. ROPER under my direction, and the so-called Roper let-off motion, which requires little or no adjustment for the size of the beam, while otherwise acting on the principle of the Bartlett, is the result. This is the farthest step forward so far, and is built on the most of our looms.

Experiments for improving it still farther have been for some time in process, and we expect to attain a device which will

weave as even cloth as the friction, and of more uniform width, while there will be absolutely no need of tension adjustment when the desired tension is decided on, and the motion set so as to give it.

Meantime we furnish either the Roper or Bartlett let-offs, or the friction if desired.

THE DOUBLE FORK

When the filling is exhausted, either with the ordinary loom or the Northrop, the absence of filling is detected by the so-called filling fork and rack arrangement at one side of the loom, and the loom is stopped with the old fashioned arrangement, while with the Northrop a new bobbin is placed in the shuttle, and the loom continues running. In either case the loom makes several picks, say from one to four, without filling being laid; while the take-up motion continues its operation.

This would mean a thin place at every change of filling, with either the common or the automatic loom, were it not for the use of a let back, or expansion catch, which *lets back* a predetermined number of picks whenever the filling fork is not raised. As the number of missing picks varies from the fact that the filling is sometimes exhausted while the shuttle is going in one direction, and sometimes while it is going in the other (the let-back operating alike in either case), there is necessarily a perceptible thick or thin place as often as every other change of filling. As thick places are less objectionable than thin ones, the let-backs are generally set to cover the greatest deficiency, and the cloth with thick places at the changes passes inspection, though really imperfect, because these blemishes are expected.

A great trouble incident to the common loom and to the automatic loom without feeler, up to date, has been the considerable number of thin or thick places in the cloth at change of filling, the automatic loom, however, having had the advantage of the absence of "thread runs" in the cloth, which are prevented by our warp-stop-motion; but the thick or thin places are a blemish, all the same, and need to be eliminated, not

merely kept down to the standard of ordinary loom cloth, but done away with altogether.

Another cause, however, makes many thin places, in spite of the let back, and that arises from the binding or sticking of the parts on goods where the tension is light. In such cases the strain of the warp is not frequently heavy enough to turn back the roll, though the let-back would permit it to revolve if it moved freely. This is worse when it occurs on automatic than on common looms, as the trouble is not discovered so soon. When the weaver is present at each change of filling and responsible for the quality of the cloth, a thin place is noticed and the take-up properly adjusted; while if the take-up of an automatic loom gets out of order, the trouble may not be known to exist for days or until the cloth is inspected.

To remedy this, and to make the automatic loom even better than the common, we have placed a filling fork at each side of the loom, so connected that taking-up is stopped whenever either fork is not lifted and the uncertain let-back is dispensed with. This arrangement will make perfect joints at every change of filling, with the exception of a possible part of a pick, and we can arrange to have this part of a pick too much or too little, as may be preferred. In either case it is far better than having one or two, or even more picks too much or too little at a large share of the changes, as is the case with single fork looms.

We believe that when this device is fairly introduced it will so improve the quality of many kinds of cloth that its use will be considered a necessity.

The use of two forks, broadly, is not new, but it is, we believe, new and valuable in connection with automatic looms, and we have covered features of value for its use with even the common loom. This is of less importance, however, as the demand for the common loom will not authorize its being made more expensive by the addition of improvements.

We have several hundred of these devices in use at Grosvenor Dale, Connecticut, and our reports indicate that they are giving entire satisfaction. We have orders for several thousand

more and expect them to become a regular feature of our machine.

THE ANTI-BANG.

We have developed and tried successfully in our weaving room a device that we have christened the " anti-bang ", because it greatly diminishes the shock and jar when the loom bangs off — that is, when the shuttle fails to enter the box sufficiently and the loom is stopped suddenly by the protector mechanism. This banging off is responsible for a large part of the breakage of pieces of various kinds, including crank shafts, and for the slippage of gears, pulleys, and other parts held by friction. It also causes more jarring loose of bolts, nuts and set-screws than all other causes put together.

No one doubts that if the effect of the sudden stoppage at full speed, which is a necessary disadvantage of looms heretofore constructed, could be reduced or eliminated, a marked saving would be made in repairs and in the loom fixer's work.

Our Mr. ROPER has invented this device, by which the frog is connected to the whip-roll by a spring connection. When the dagger strikes the frog there is no sudden stop, but the frog moves forward against the force of the spring, and when the point is reached where the shuttle would break out warp with the ordinary loom, the whip-roll is automatically moved forward and no breakage occurs. This arrangement lengthens the time of stopping when the shuttle fails to box, and by this and its cushioning effect it reduces breakage and jar to a very great extent. It also reduces the breakage of the warp as looms are ordinarily set. Our fixers report that it greatly reduces their work also, as parts once set are likely to retain their position and bolts, nuts and screws all over the loom require much less frequent attention.

We are about sending out a number of these attachments for mill test and shall decide on its adoption after this trial. We shall not adopt it generally unless it shows a clear advantage in practical use, as it will add something to the cost of the machine.

This is a consideration that we take into account when no evident gain is made by extra cost. When, however, we see a real gain for the user of the machine by adding mechanism, we do not let a difference in cost stand in the way of its adoption.

GENERAL IMPROVEMENTS.

Outside of these special mechanisms that I have mentioned, there have been many improvements in detail, requiring invention, as shown by the long list of patents that we have taken out. Independently of invention, however, we have considered substantially every piece that makes up the loom, as to its strength, weight, proper location and convenience in getting at it in case of repair. We have examined our repair orders to find what breaks or wears, and where and why, and have used our best endeavors to improve the construction in all such cases. If complaints come from mills, the troubles complained of are carefully investigated, and if the mechanism is found at fault, as it sometimes is, we do our best not only to remedy the difficulty where the complaint is made, but to avoid it in looms built afterwards.

We have also continuously endeavored to improve our mechanical work and to keep it up to the standard, where a satisfactory standard has been established. And all of this has produced its effect. Our looms now sent out start better and run better than those first made and with materially less repair. In this particular, though perfection is hard to reach, we do not expect to make great further advance.

What we do expect to do is to fit the loom for an increasing variety of fabrics, to improve the quality of the cloth produced till Northrop loom cloth is acknowledged to be the best, as well as the cheapest, and to overcome certain difficulties that have heretofore been incident to the operation of all power looms. The process may be slow, but our motto is "Excelsior" and meantime we know that we are furnishing today the best weaving machine ever built.

In closing I will add a report of a visitor to one of the larger

users of our loom in regard to its popularity among the weavers who make cloth with it. He says: "I spent considerable time in going through the looms that have been running the longest and found them running as well as, if not better than ever before. The overseer tells me they are getting about 94 per cent. of the product, and his help is all family help. He also stated that if one of his weavers goes away to work on a common loom he is not gone more than a month before he gets back. I find this to be so in other places also — once let a good weaver get used to Northrop looms and he never wants to run common looms again."

If there is any point that I have not touched upon I will be glad to answer any questions.

The PRESIDENT. The session will now stand adjourned until 2.15 o'clock this afternoon.

SECOND SESSION.

WEDNESDAY AFTERNOON, APRIL 22, 1903.

The Association met in Chipman Hall at 2.15 P. M., President FISH in the chair.

The PRESIDENT. Gentlemen, if you will please come to order we will proceed with the reading of the first paper of the session, Local Transportation in Mill Economics. Mr. CLARENCE J. MESSER, Boston, Mass.

*LOCAL TRANSPORTATION IN MILL ECONOMICS.

CLARENCE J. MESSER, Boston, Mass.

Undoubtedly there has been treated at these annual gatherings many subjects which would appear to be more closely related to cotton manufacture than is transportation, yet history proclaims otherwise to a remarkable degree. Wherever invention has brought subservient to man's necessities this beautiful product of a wonderful plant, transportation has handed the material to the machine, thus entering upon a guardianship which extended through numerous stages of manipulation until the finished fabric was secured. The heritage of cotton, the king of all textile products, is helplessness, for from the bursting of the boll to the decay of the manufactured article it must be borne by human agency and direction to a far greater extent than must any other matter, either vegetable or mineral, that the earth produces.

Presumably, every member of this Association knew in his early youth that the first exploitation of cotton was made at Ahasuerus' feast. The scriptural book of Esther tells that Ahasuerus, who reigned from India even unto Ethiopia, over a hundred and twenty-seven provinces, gave a feast to the nobility of all peoples, and that the court of his palace was festooned with white, green and blue hangings the like of which were never before seen in that part of Asia. This event occured 500 years before the Christian Era.

The name, Ahasuerus, does not appear in profane history,

* For further references to this subject see Transactions as follows: Vol. 61, p. 348, EDWARD W. THOMAS, Transportation of Cotton from Storehouse to Rickers, and of Cloth from Weave Rooms to Cloth Hall.

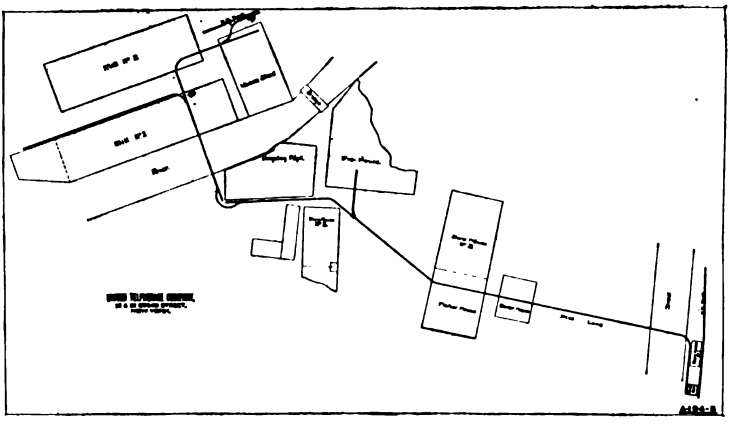

FIGURE 1.—The Cotton Manufacturing Plant presents many Transportation Problems.

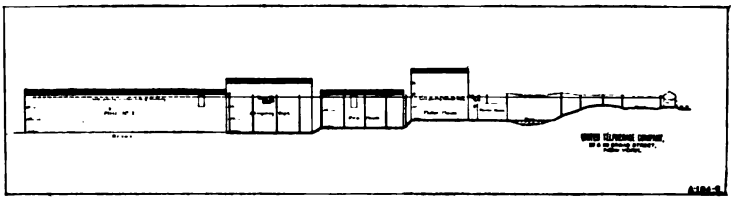

FIGURE 2.—The Science of Overcoming Severe Topographical Conditions.

FIGURE 3.—The Telpher is as Simple as it is Powerful.

FIGURE 4.—The Electric Hoist is a Beautiful Piece of Machinery.

but it is no evidence of disrespect to affirm that the ruler is entitled to the credit of being the only person who ever successfully worked a corner on cotton cloth, muslins, prints and calicuts. The achievement is more a subject of commendation when we consider that Persia, to the north of him, had become through its commerce, the greatest kingdom on earth. Situated at the western extremity of a great desert, Persia supported trade routes and protected them from the encroachment of the desert robber, and for a hundred years the silks from China had entered the country and found there a safe unloading place for a distribution among the Mediterranean ports. Along some of these routes also came wool and camel's-hair, from which less expensive wearing material was made, and finally came cotton.

It must be a source of gratification, as it certainly is of profit, for members of this Association, to contemplate that although in whatever period of the world's history a Crœsus might array himself in fine raiment, and wear priceless jewels, he is subject in hot weather to that same uncomfortable perspiration which affects an ordinary man, and that together they crave that habiliment, homely in name and character, the non-irritant, greater absorbant cotton shirt.

It was so in the time of Ahasuerus, and when the magnificent Crœsus of Lydia, and his nobles, heard of the properties of the new textile material they had to have it, "f. o. b. Sardis, market price, draw on sight." Soon camels came swaying across the desert bearing cotton in such quantities that Ahasuerus had to let go his monopoly under stress of unlimited importation.

Silk, wool and camel's-hair still remained the wearing material for the commonalty for the reason that such products soon became indigenous. The silk worm, the sheep and the camel followed the spreading civilization, bearing their valuable commodities on their backs thus very profitably for the owner, entering industry under the dual capacity of producer and importer. It would be imposing on your time if I should go into the story of the Vegetable Lamb of Tartary, that fabulous myth, a plant with animal life, with bones and flesh which was supposed to thrive

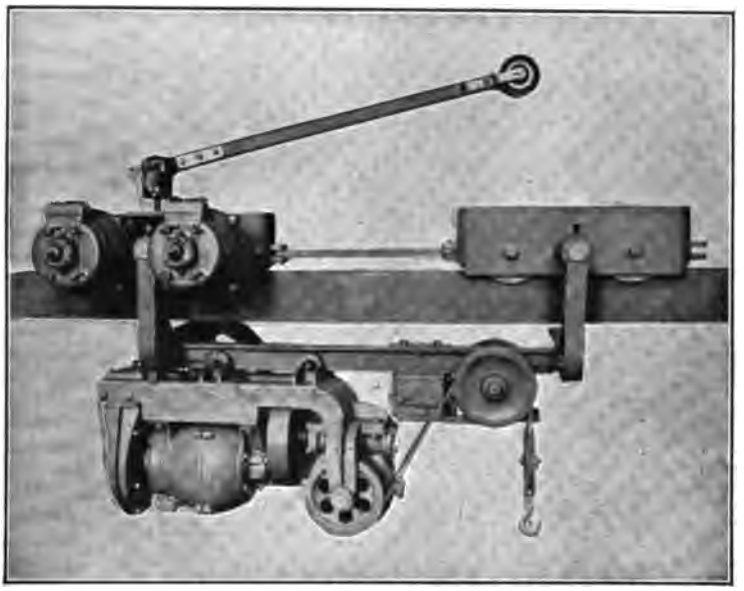

FIGURE 5.—The Combination of Telpher, Trailer and Hoist unites three powers heretofore considered distinctive.

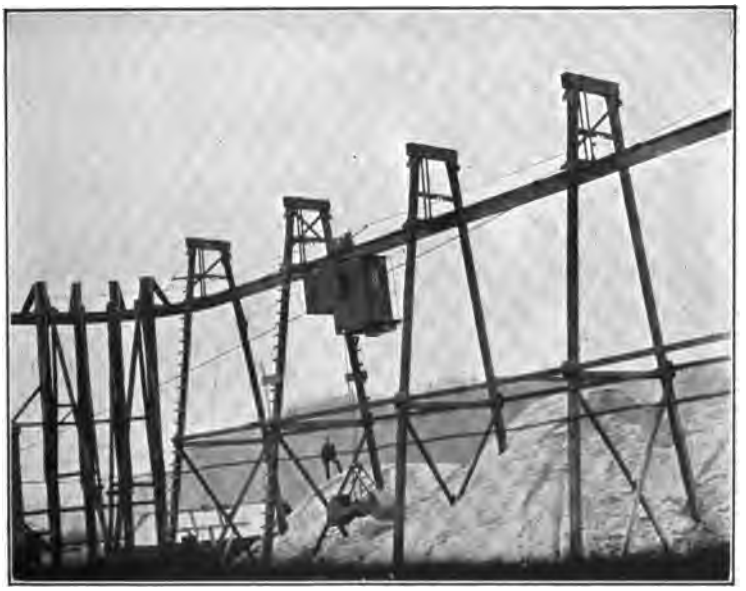

FIGURE 6.—The Telpherman has a long reach.

in far away countries, which ate at night, being bended to the sward by the breezes, and from which, civilization was told, came cotton. Even the Greeks hoped for years to finally domesticate this strange animal, or thing, and secure its product from the almost prohibitive transportation charges, but in 445, B. C., Herodotus, the historian, blasted their hopes and at the same time threw them into amazement by writing, as a result of his travels:

"The inhabitants of India make this clothing of the product of a certain plant which, instead of fruit produces wool of a finer and better quality than that of the sheep."

The secret was out. The heritage had fallen and the helplessness was soon made greater pronounced by Theophrastus, a diciple of Aristotle, who had gone on the famous expedition of conquest into India, under Alexander the Great.

"The wool bearing trees have grown longer than man's memory" wrote Theophrastus, "They bear no fruit, but a capsule which, when closed is about the size of a quince, and when ripe, expands so as to emit a beautiful soft wool or down, which the natives make into cloth, either coarse and cheap, or fine and of great value."

Cotton was always an expensive article to the Greeks on account of its dependence on transportation. We may never know through what medium it came to our own continent but when Columbus first made port at the Bahamas he was solicited to barter for fine yarns and thread which the natives brought out to his ships in their canoes. Pizarro found cotton manufacture established on a pretentious though primitive scale when he came to Peru, and Cortez sent to Charles V splendid mantles made from the cotton produced in Mexico. The climate of these latter localities permits of the plausibility of an indigenous theory, but however the conception, the fact remains to be disputed that even in the production of these earliest known materials from the wonderful plant; through the rude ginning, spinning and weaving; transportation was the most prominent feature in the entire construction. Having attempted thus to

FIGURE 7.—The Load may be Deposited at any Desired Point.

FIGURE 8.—In spans over rivers the running cable has a double, triple or quadruple suspension.

establish our premises, we will pass over that enormous amount of conveying which attends the fluffy substance before it arrives at the doors of your storehouses, and take up that portion which comes under the subject of this paper, " Local Transportation in Mill Economics."

A novice who enters a twentieth century cotton manufacturing plant is at first dazed by the noise, then amazed by the capital expense on display. If the observer has had a commercial training he will not be long in finding a solution of the vast cost in machinery, in such an immensity of output that a unit of mensuration has been struck at a very high economic ratio. Considering the cost of the same output if the manufacture had been accomplished by hand, the visitor becomes more than ever imbued with an idea of the stupendous energy in capital.

" That machine cost a thousand dollars," he figures. " There is here employed $50.00 in interest, $50.00 in depreciation, $20.00 in power, and $600.00 yearly for the wage of the one laborer who operates it; a total of $720.00. Without the machine the wages of ten men would not produce a like amount of material."

With the matter strongly impressed on his mind, he may, perchance, go to another part of the plant where he will receive quite a different impression. He will find that from six to twenty men are employed in lugging beams of yarn on their backs from a store to beam frames. He will see a company of young men trundling small vehicles of bobbins, they finally departing to somewhere with the unloaded vehicles. A continuous line of men are trucking warps hither and thither. Going out into the mill yard he will observe that a corps of men are pushing boxes of yarn between buildings. A double team attended by four men is conveying four bales of cotton from the storehouse to the picker room, over something like 800 feet of distance, when the two buildings are but 300 feet apart in a straight line across the canal. Teams are employed in conveying between the freight sheds and the storehouses. Coal is being brought in carts from the pocket to the boilers and men are laboriously

FIGURE 9.—Working faithfully, though unattended, and a mile from home.

FIGURE 10.—The sinuous track through the mill.

lifting cases of finished goods to the drays to be transported across the street to the freight house, there to be as laboriously lifted from the dray to the platform.

The situation has become decidedly paradoxical and the visitor begins to speculate as to why the capital energy is being expended so entirely outside the transportation end of production, when transportation is so large a part of the business.

There is a reason. Those machines which turn out such enormous product forced themselves into cotton manufacture. Of several reasons which explain why capital has not taken hold of the local transportation end of the problem to a greater extent, one is — that no like condition has ever existed in this aspect of the industry, another — up to within a comparatively short time no machine was ever perfected that could improve on the efforts of man and horse.

In an able work entitled "Compendious History of the Cotton Manufacture," written by RICHARD GUEST about the year 1828, the cause of the introduction of elaborate machinery into the production of cotton textile fabrics is thus explained.

"A reed maker of Manchester, England, one THOMAS HIGHS, happened into the house of a neighboring cloth maker just as that person had returned from an ineffectual search for wefts. At this time spinning and weaving was done by man, woman and child, all over a district, and every town possessed a few rude hand looms. HIGHS heard the story of the disappointed merchant, whose continual plaint was, 'There is even now not enough wefts and what will the future show, when newly discovered cotton producing sections are sending to us more raw material than we have ever before had.'"

"HIGHS went to work on a contrivance which would assist in producing sufficient wefts to supply the market, meeting with disappointment and ridicule, but ever persevering until he had produced a machine about a yard square, which worked six spindles successfully. This machine he named after his daughter Jenny. The inventions of HARGRAVES, ARKWRIGHT, and CROMPTON, followed."

FIGURE 11.—An Automatic run across the yard and over the canal with sixteen hundred lbs.

FIGURE 12. — No necessity of a long detour in crossing between the mill and storehouse.

It will be seen that a demand exceeding a supply forced the invention of the spinning Jenny, then was forced the throstle, the carding engine, and the loom, and so on, the increased material from the invented machine calling another invention into existence to push a steadily increasing partial product to a finished fabric.

Considering the other side of production;—In a general sense demand for transportation facilities has never exceeded the supply. Men are plentiful and they can move weights. Horses are especially designed for that purpose, and, following that thought, it is wonderful to consider how far they have already been displaced from that for which they were designed, by man's ingenuity, for the benefit of humanity. It has ever been the rule that a sufficiency in any article hinders development along that line, but what I would now show is that the complexion of the argument changes when an effect on mill economics is concerned. I wish to demonstrate that in the last few years there has appeared a machine for transportation about cotton mills which will not only yield a greater interest on capital than any machine which attends strictly to manufacture, but will give a convenience, a rapidity of service such as has never been known about your premises. I refer to the telpher.

The horse is not an expensive article about your manufacturing plant, even though he is idle one-half the time out of a working day, and though his energy is in no way comparable with that of steam or electricity when he is actually at work. It is the preparation of the load for the horses' services, which runs up transportation cost. Even though the price of the horse should be pitted against that of the telpher, the advantage would be in favor of the latter on account of a greatly accelerated speed of movement, but I wish to show you that there is absolutely no comparison between the values of the two mediums of transportation.

Recently I stood 40 minutes to observe the movement of five cases of finished cloth from the packing room to the storehouse. In the operation six men and two horses were employed. Three

FIGURE 13.—To the storehouse or freight car. Five hundred feet and return in three minutes.

FIGURE 14.—One handling of coal from car to boilers.

men ended the cases upon a truck and wheeled them to the elevator, then a drop was made to the ground floor. The combined effort of five men was used in getting the cases from the elevator to the platform of a dray. A driver handled the ribbons while the load was moving the 600 feet to the storehouse, the five lumpers being part of the load, then, at the other end of the line the six men were required in the unloading of the dray and the conveying to another elevator which in two loads took the material to the second story of the storehouse, where men, not accounted for in the illustration, loaded it again and wheeled it to its resting place.

It was a rather singular analogy that inside the buildings of the various departments of the plant, expensive machinery was being driven to its utmost capacity that the cost of production should be reduced, while here was at least 240 minutes of manual and animal labor expended in a simple problem of conveying. The cost for this operation, not including time of horse, interest on horse, wagon, harness, etc., was at least 60 cents.

I will tell you what that 240 minutes was worth to the agent of that mill, and to his stockholders, if an equally careful surveillance had been exercised in indoor, and out of door economics.

Fifty cases of the same weight could have been transported between the same discharging and receiving points, the energy employed being a telpher outfit, a telpherman and a helper, and the entire cost, reckoning interest on plant, depreciation, power and wages, would be less than one dollar. I would like some mathematician to figure the loss in capital energy by reason of the cited carelessness on the transportation side of production.

It is no exaggeration to claim that there is not a cotton mill in operation which could not materially reduce cost of production if the usual carefulness of detail was extended to the transportation end. It is, however, no fault of the agent that this is so. An agent is busy enough in caring for phases of the business which are continually demanding his attention and he may be excused if the knowledge has not come to him that in the past

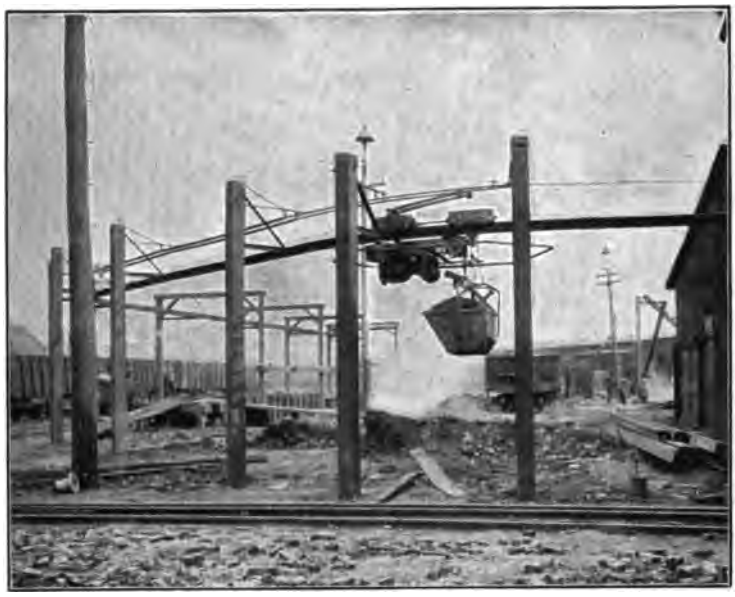

FIGURE 15.— Demurrage is a thing of the past, with an installation like this.

FIGURE 16.— Bound up a 12 % grade and around an S curve to storehouse No. 2.

two years an entirely new significance has been given to the term "local transportation" by the strides of progress made in the science of Telpherage.

Telpherage is derived from Greek words and means far-carrying, the first syllable holding the same value as that in the words telegraph and telephone but in telpherage it will be shown that the lightning speed of transmission which the telephone and telegraph attains is more than overbalanced by special powers outside of transmission. A triumvirate of effects, hitherto considered subjects for separate treatment have been harnessed to operate co-jointly, the union consisting in a compactness of design, an enormity of efficiency and a consequent economy of operation which is not equalled in any other device in the world. Like HIGHS' spinning Jenny the telpher was but the foundation of a science. Not until the electric hoist was made a part of the installation did the capabilities of the telpher begin to show themselves, and the transposition of the hoist movement completed the unity, and bestowed much commercial value on telpherage.

In order to show wherein telpherage overshadows all other sciences in local transportation, I call your attention to the plan of a cotton plant which presents very peculiar conveying problems. It must be remembered that telpherage is electrically driven in all its functions, and secures its contact through the trolley, as does a street car.

The requirement for transportation in your mills is largely during the day time, consequently the electric plant which furnishes your incandescent lighting at 110 or 220 volts will furnish power for telpherage with but little additional cost for oversight. As in street car operation, frequency in starting and stopping can best be controlled from a direct current, rather than from the higher speeded alternating dynamo. Again, the two and three phase aspect of the latter adds to the cost of telpherage installation, still, by the use of converters and transformers, even this harshly undeviating force constant, may be made docile, and harnessed for telpherage propulsion. Concerning its oper-

FIGURE 17.—The touch of a switch lifts 10,000 lbs. from the floor.

FIGURE 18.—A thousand feet a minute on a straight line.

ation, telpherage installations may be automatic or non-automatic but in the illustration now given, the telpherman rides on his machine. (Figures 1 and 2.)

With a machine and an assistant, a telpherman can convey 250 tons per day over a distance of 1,000 feet. The conveying differs from the general meaning as attributed to that word when it is considered that the telpherman takes entire charge of the loading, the carrying and the unloading. You will now observe why the services of the six men in the illustration of cloth conveying was wasted energy. How many men and horses would be required in the lifting, conveying and depositing of 250 tons in ten hours, and when all is reckoned score still an advantage for telpherage as it occupies space hitherto considered useless in the plant. Snow, ice, or frost thrown surface, cannot make more difficult the transportation problem, for telpherage runs in the air. The track is usually at least twenty feet from the ground and the material to be transported is suspended beneath, the supporting arrangement presenting no greater obstruction than would be encountered in an overhead bridge. The telpherman can reverse his machine at will and when out of commission for even an hour the plant becomes a non-consumer except in interest charges.

Out of doors the track may be constructed of solid steel or of steel cable, the latter being invariably used in long spans over canals, river gulleys, railway tracks, or when the line is to run at an altitude of 50 to 100 feet. Under such latter conditions the running cable track is supported between posts by C shaped wrought iron hangers, which have an upper grasp on a stout suspension cable and a lower clutch on a three foot bevelled shield into which the running cable is sunk. The tightening of the suspension cable not only prevents excessive sagging of the running cable under a load, but maintains it at a slight elevation so that when the telpher crosses the shields, the track is level. In all cable installations the spans, which are nominally fifty feet, have this simple suspension, but over rivers, double, triple and even quadruple suspensions are required, the necessary sus-

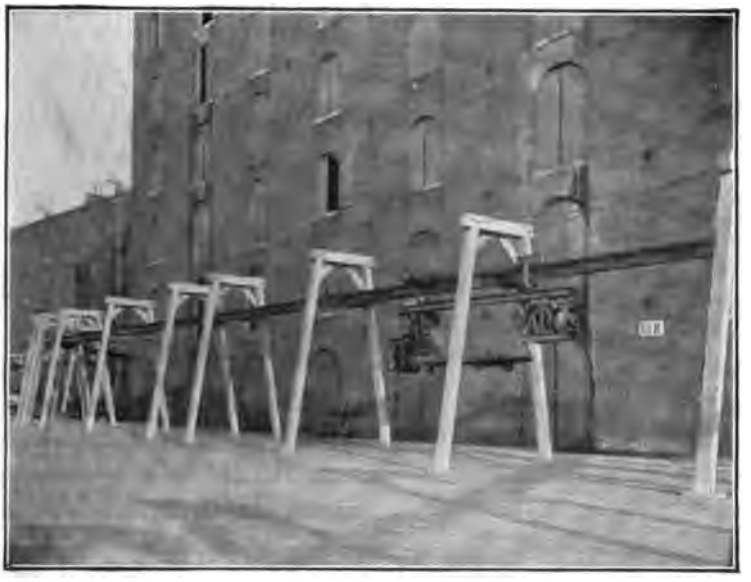

FIGURE 19.—The load is deposited on to a dray, on to the ground, on to a railroad car, or where you wish.

FIGURE 20.—Attending strictly to business 97 feet in the air.

pension dip being secured from high structural steel towers at either side of the depression.

The telpher, or locomotive, is of the simplest construction. Except when heavy grades are to be traversed it is without gearing, the running wheel being placed directly on the motor shaft. In concentrated conveying, or where the load is suspended from one point, as in automatic cask or coal carrying, a follow wheel is affixed to the telpher frame to prevent excessive pendent acuteness, while for distributed loads a two wheeled trailer is attached to the telpher by a connecting rod. Invariably the trailer is used where a telpherman operates the machine. The trolley wire is above the track, but inside buildings this wire may run alongside, inclosed in a conduit, thus absolutely insuring safety against conflagration. The track for inside work is solid steel supported every 15 feet.

In the illustration here shown the telpherman attacks the coal pocket or the freight shed at the railroad track, for commodity to be transported to the different parts of the plant. If he is handling coal he may use a clam-shell bucket, saving a considerable cost per ton over the ordinary method of shovel filling. Grasping the coal in one closing of the bucket, he raises it either 5 or 50 feet by the touch of an electric switch, the speed of the lifting varying from 15, to 35 or 60 feet to the minute, then by another switch he moves his ton of material through the air at a speed of 1,000 feet a minute until he comes to the boiler house, when the last of his powers is exercised, he dumping the coal through a chute to a point directly in front of the furnace doors, or into a bin at the top of the boiler house for later use, or placing it directly on the ground. In this lifting, carrying and unloading, the telpherman works alone. His control over the self-filling bucket is as complete as is that of the hand laborer over his common shovel.

Returning to the railroad the bucket can be shifted and a platform carrier attached, in which miscellaneous freight may be transported, or if bales, cases, beams or boxes are to be taken, sling chains are used. In passing between the floors of

FIGURE 21.—Automatically deposits its load, automatically reverses its direction and returns for more.

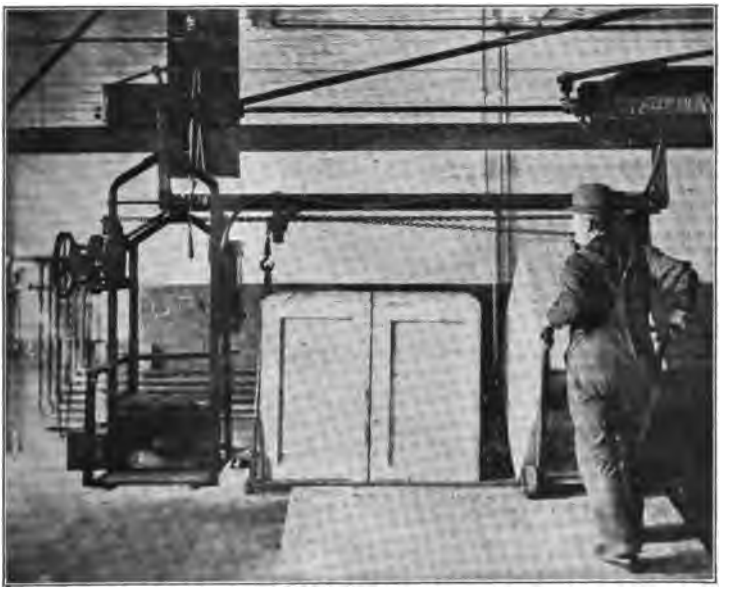

FIGURE 22.—The Telpherman loads, conveys and unloads.
This machine leaves from second floor and enters at a second floor. No elevators or lumpers used in installation. All elevating from a lower level done by telpherman.

a building, floors at a lower level can be served either through a well or on the outside of the building where the telpherman can lower his hoist grapple, a platform carrier, or whatever vehicle he uses, to a landing. His assistant, or an employee regularly stationed on that floor, can affix the hoist chain, the telpherman touches the switch and up the load comes, a distance of 50 feet if desired, and away it goes to the mill or railroad.

Over buildings, around corners, across rivers, sometimes bracketed to the sides of buildings, at others supported in the open land on A bents, switching on to branch lines via track switches which the telpherman himself operates, opening and closing doors, running the entire length of the storehouse and picking up a load without a particle of previous preparation, — such is telpherage. In or out handling is the same to telpherage, whether the distance is fifty feet or a thousand, whether the haul is back and forth between different departments, or over the full length of the line, and in either work, the effect on mill economics is the same. Cost is decreased. Man is the most expensive medium for transportation that was ever used in the capacity. Telpherage will do the work at a saving, thus allowing the man to receive greater wages in the more intricate parts of fabric production.

Through "around the plant" conveying by team, local transportation in mill properties often reaches as high a cost as 40 cents a ton. Telpherage can reduce that cost to five to eight cents per ton. On a hundred ton per day proposition, this reduction means a saving of $10,000 per year, in many cases more than the entire cost of the telpherage plant.

The depositing part of telpherage is by no means the least important. From a height of 30 feet, or even more, the 1,000-pound case of goods can be deposited on to the dray or railroad platform without a pound of human exertion. In lowering from a higher story to a landing one or two stories below, the deposit can be made on to a truck which can be easily drawn inside and to the desired location. Unloading and loading, therefore, become attributes of telpherage which should appeal to the mill economist.

FIGURE 23. — Over the freight yard and drop the load to the level of the freight car door.
Former cost of conveying 30 cts. a ton, present cost 4½ cts.

FIGURE 24. — Here you see the way we do it, and the way we used to do it.

The automatic feature is worth the attention of mill agents. Coal finds in this part its most economical method of movement. The bucket travels the route, automatically dumps the load, automatically reverses its direction, returning to the starting point. Seventeen hundred feet have been run by one of these automatic machines before the second bucket had been filled for transport by the shovellers. In any problem where there are distinct starting and unloading points the automatic system finds adaptability. The electric hoist is also a part of this installation, consequently there are many conditions under which lifting, conveying and depositing can be accomplished without the expense of a telpherman.

The trolley wire in the automatic installation, is divided into sections, each controlled by a switch, conveniently located. The cutting of the current from any section immediately stops the machine. Upon approaching a curve, the telpher finds a lower voltage by reason of a resistance which intercedes between the motors and the source of current and there is an automatic slowing down. When past the resistance affected section, the higher speed is again reached.

Through a steadily climbing economic ratio in steam and electric energy the transportation of raw material, finished product, fuel and supplies is now the live issue in the location of a new cotton mill. There is no longer absolute necessity for a water power privilege, for the question of freights has been largely equated with that of machinery moving expense and mills are being build on railways. To the cheapened machine driving force, and a more convenient and accelerated despatch between the fields where the cotton flower blooms and the manufacturing plants where it is converted into wearing apparel, should be joined the additional convenience and triple effect in expense reduction which is secured in telpherage — that science which allows of the raising, conveying and depositing of the contents of a freight car without the employment of one pound of human energy — and you have the economic climax in mechanical power for the next quarter of a century.

It must be evident to you that every problem for telpherage requires distinct engineering study; yet solidly founded principles are employed in the solutions. There have been few cases of telpherage installation where the original project was strictly adhered to. The first source of increased revenue from expense curtailment introduced another opportunity, then another, until the effect on economics became considerable. From immense handling to the most delicate of conveying requirement, telpherage operates with tireless perfection, performing almost human effort.

From the time when the railway train and the steamship supplanted more primitive methods, transportation has been a source of wonder for all mankind, but where is the other science in movement which allows of a boy lifting 10,000 pounds at a speed of 35 feet a minute, by the simple touch of a switch, by another touch sending it flying through the air 1,000 feet a minute, then holding the load suspended, to be dropped at his will to a desired point, with absolutely no handling in the entire operation by a helper. Again, as though to demonstrate its wonderful scope the same principles are employed for an automatic crossing of a 200-pound package 90 feet in the air. It is a mighty contrast in requirement but both problems are operated with precision and surety.

Simplicity is the key to economical operation in mechanics. Telpherage is the acme of simplicity. A careful study of your premises with reference to an application of this science can result in a higher ratio of mill economics.

The PRESIDENT. Any questions to be asked, gentlemen? If not, we will proceed to the next paper, Improving the Cotton Fiber, Dr. H. J. WEBBER, Washington, D. C.

*IMPROVING THE COTTON FIBER.

Dr. H. J. WEBBER. In charge of Plant Breeding Laboratory, U. S. Department of Agriculture, Washington, D. C.

It gives me great pleasure to have this opportunity of presenting some of the work of the Department of Agriculture before you, particularly that portion of the work bearing on the improvement of the fiber of cotton. No matter how much we may attempt to improve the fiber from our standpoint, it must necessarily meet the requirements of the manufacturer or all of our work will be valueless. You gentlemen — you as manufacturers, are the final judges of whether a cotton of a certain variety is sufficiently valuable to be cultivated generally. But now if I may venture a word of criticism, — I doubt whether many of you know much regarding the different varieties of cotton. This lack of knowledge, regarding varieties, I may say, is general in the manufacturing world. Very few men who are engaged in the manufacturing of wheat flour know very much about the particular varieties of wheat. They buy this wheat or that wheat, Minnesota No. 1 or Minnesota No. 2; having no special knowledge regarding the wheat other than that it has certain properties which meet their requirements as a whole.

We can never realize the greatest benefit and value from any particularly fine variety until buyers, manufacturers, and

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* For further references on this subject see Transactions as follows: Vol. 18, p. 49, JOHN BUTTERWORTH, Lecture on Cotton; Vol. 59, p. 110, EDWARD ATKINSON, Improvement of Cotton; Vol. 66, p. 383, EDWARD ATKINSON, The Fibre of Cotton; Vol. 66, p. 391, CHARLES L. NORTON, Tests of Cotton Fibre; Vol. 71, p. 204, HENRY G. KITTREDGE, The Cotton Fibre in some of its Phases.

all concerned come to recognize the variety and sell and handle the product under the varietal name. Let me draw an illustration from a horticultural standard which I think most of you will understand. If you are familiar with apples, you never buy a Ben Davis apple to eat out of the hand. It is the finest apple in appearance on the market; it is highly colored; it always comes into the market in good shape; but it is of poor quality, and pithy. The man who has a knowledge of apple varieties will never buy a Ben Davis and the same criticism is applicable to a number of our varieties of cotton. We must know more about the varieties. We must have a knowledge of the actual quality of the article produced by different varieties before we can reach the highest development.

Our experimental work has been carried far enough so that we are certain that very marked improvements in cotton fiber can be wrought. The greater part of the cotton which is cultivated in the United States, in the Upland cotton belt from South Carolina to Texas, as you doubtless know, is with few exceptions a staple ranging from ¾ of an inch in length to 1¼ inches at the most. Off the coast of Charleston, S. C., on Edisto and James Islands, on the other hand, we produce the longest and very best fiber that is grown anywhere in the world. I think we, as men interested in cotton, should sound this as a war cry.

Only a small quantity of this fine cotton is grown, and the demand for the very fine grades is limited. It is highly important, however, that we grow a longer and better fiber in place of the ordinary short staple of which we produce such a large quantity. The aim of the Department of Agriculture is to encourage the growing in short staple cotton regions of varieties producing longer and better fiber. There would seem to be no reason why varieties producing better staple cannot be successfully and profitably grown, and our aim is to produce such varieties if no satisfactory ones exist at the present time.

IMPROVED LONG STAPLE UPLAND COTTON.

We already have a few varieties, the so-called long staple uplands, that produce a fiber from 1⅜ to 1¾ inches in length. These are grown quite extensively in the so-called Delta region of the Mississippi and in a few other isolated localities here and there. These so-called long staple upland varieties like Allen's Improved and Griffin, Allen's Hybrid, Doughty, and some others, are very largely hybrids between the fine Sea Island cotton and the ordinary short staple upland. The short staple upland cotton is the pride of the grower, so to speak. It is productive and yields heavier than any other cotton which he grows. It has a large blunt-pointed boll, which opens up well and is easy to pick. The darkies have no difficulty in picking it; they do not complain. On the other hand, if he grows the finer, long staple cotton, and attempts to send the ordinary pickers into the field, he hears them continually complaining, and has to pay them about double price for picking, so that he prefers to grow the short staple upland sorts. The proposition before the scientific plant breeder is the production of a cotton which will have the large round blunt boll of the upland cotton, that opens up nicely and is easy to pick, and has a fiber more nearly resembling that of the Sea Island. All of the long staple upland cottons, like Griffin and Allen, largely have these requirements; that is, they have large bolls, that open fairly well and they give a fair yield, but little below the ordinary upland. Unfortunately, however, the fiber of all of these varieties is very weak and the seeds are fuzzy or tufted so that a roller gin cannot be used with any degree of success to gin them.

I do not know whether it has come to the attention of the manufacturers or not, but the complaint is somewhat general that sewing thread as a whole is weaker than formerly. This complaint is common among housewives. It may be all traditional, or an old-maidish fancy, but there may be some reason for it. I understand that long staple upland cotton is largely used in the manufacture of thread, and all of these long staple uplands that I have personally examined fall down in

strength of fiber. They are very weak, as a matter of fact, and I judge that this may possibly afford an explanation of why cotton thread is becoming weaker. The cultivation of such long staple uplands has only recently become sufficiently extensive to have any noticeable effect. I may be mistaken in this interpretation, but facts point in this direction. Fortunately we know now, from experiments which have been conducted, that those varieties which produce weak fiber may be largely improved in this regard and can probably be brought up to a standard of strength practically equivalent to that of other varieties.

One of the principle aims of the Department, as I explained a few moments ago, is to produce hybrids between Sea Island and upland cotton which will have the long fiber and black seed of the Sea Island and the round, well opened bolls of the upland. We have grown probably 40,000 or 50,000 hybrid plants within the last few years in an attempt to secure something of this kind. As a result of careful selection from these we have now fourteen different strains which we are attempting to fix into staple new races. Practically all cotton growers tell us that it is impossible to fix a type of hybrid cotton — that is, tofix it sufficiently so that it will come uniform enough to be of practical value. I confess that we cannot contradict this statement as yet; I can only say, however, in this connection that after three years of selection there is a constantly increasing number of the plants that come true to the desired type which we are trying to fix, and I am fully convinced that in time we shall be able to render them as uniform and unvariable as any of our standard varieties.

As one of the parents of these hybrids, instead of using the ordinary upland, the seeds of which are fuzzy and tufted, as the growers express it, that is, having short fibers, we took a specially bred form of upland cotton known as Klondike, which has smooth black seeds. This black, smooth-seeded Upland type was bred by Mr. W. A. CLARK, one of the large cotton growers and cotton manufacturers of the South who is particularly interested in this problem. It is very desirable to get a cotton that

will have black, smooth seed if it has a long staple, so that it may be ginned satisfactorily on a roller gin.

The grade of cotton which we are attempting to produce, however, is midway between the fine Sea Island and the short upland, not the very fine Sea Island, and it may not be found necessary to use a roller gin in handling the product. Such long staple Upland cottons as Griffin and Allen, having a staple from 1½ to 1¾ inches in length are regularly ginned on gins of the saw type, and yet the fiber of these varieties sold in the New Orleans market this year in September for from 14 to 17 cents per pound, a price slightly in advance of the ordinary market price of Egyptian cotton. It would seem from this, that when care is used in running the gin the fiber is not very seriously injured. To get the best results with a saw gin the saws must be sharpened square across and the edges dulled by use before the long staple is ginned. In the process of ginning, furthermore, the speed of the gin must be reduced about one-half. If these precautions are taken it would appear that the product is not very seriously injured. If the ordinary saw gins can be utilized in ginning the long staple uplands it removes one of the most serious obstacles to the extension of the cultivation of such cottons. Saw gins can be found conveniently located in every village of the South, while roller gins are accessible to growers only in the recognized long staple regions of southern Georgia, Florida, and eastern South Carolina.

In the case of the hybrids which we are breeding, practically all of them are being selected to smooth, black-seeded types, as it is thought that this is preferable, regardless of the desirability of having them so that a roller gin can be used. In the first generation all of the hybrids are nearly uniform having large pointed bolls, black seed, and fiber about 1⅝ inches in length. They are nearly intermediate between the two parents in their main characters and are uniformly very vigorous in vegetative growth but are as a rule somewhat unfruitful. In the second generation the hybrids split up into all sorts of types and it is in this generation that the desired types must be selected. In

this generation some plants resembled the Sea Island almost wholly, some the upland, while all grades of intermediates could be found. It was in this generation that the 14 types mentioned above were selected which are being improved and fixed into stable races. These 14 select types have bolls of varying size but uniformly large and of the upland type (Plate 1, figure 2), and also have black smooth seed and lint from 1⅜ to 1¾ inches long. It is the aim of the Department to secure several different strains having fiber of different lengths, so that they will meet different demands. Some of these hybrids are very productive, and there is every reason now to believe that they will be fixed into valuable new races. About two generations more will be required before the final outcome will be known.

IMPROVEMENT BY SELECTION.

It has long been known by agriculturists that by selecting seeds from the very best plants — that is, those which are most productive and those which produce the finest and best fiber — that we may increase these qualities. There is, in plants as in animals, a principle of heredity; in general, like produces like. Those individuals which have certain desirable qualities we must plant by themselves and select seed from the best among the progeny until we have produced a race which transmits the desired quality.

One of the most striking instances of the improvement of a race of cotton by selection, which has come under the writer's notice is that of the Sea Island cotton. When this cotton was introduced into America, some years before the War of the Rebellion, it was a perennial plant of too long a season for growing successfully in this country. By careful selection of seed from the earliest plants the cotton was changed in season until it produced a good crop in this country and became apparently thoroughly adapted to our conditions. The growers of Sea Island cotton, furthermore, have always paid careful attention to the selection of seed from plants producing the best fiber. As a result, the fiber has increased in length fully three-fourths

of an inch, and has increased also in abundance and uniformity of length until the carefully bred varieties produce the finest fiber grown anywhere in the world. The growing of this fine cotton, however, entirely depends on the annual selection, and if for any reason the selection is interrupted the product rapidly deteriorates.

The annexed diagram illustrates the general plan of selection which is followed by some of the most careful cultivators of Sea Island cotton in South Carolina.

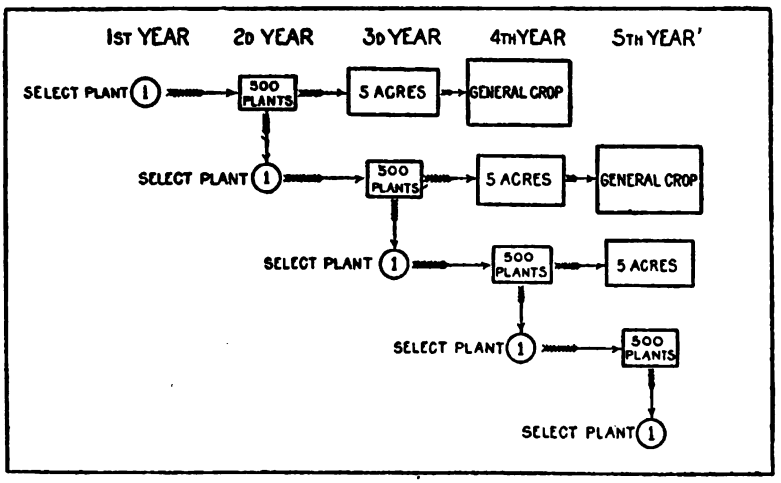

FIGURE 1. — Diagram illustrating method of selecting cotton.

DIAGRAM.

The method is based on the selection of a single individual plant each year. In the first year one superior plant which has all of the qualities that an ideal variety should possess, is carefully selected from the examination of a large field. This one selected plant in the second year will give about 500 plants, at least, as a good cotton plant produces about 2,000 seeds. In the third year the seed from these 500 plants will plant about five acres, and the seed from the five acres will in the fourth year plant the general crop. The method followed is to

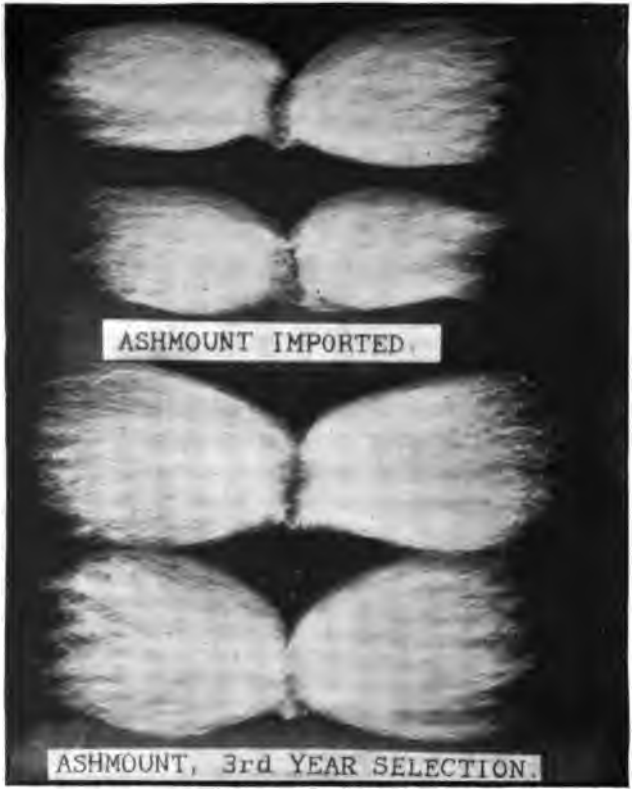

FIGURE 2.—Two seeds of imported Ashmount Egpytian Cotton (natural size).

FIGURE 3. — Bolls of select long staple Upland Hybrids. (natural size).

make a continuous selection, so that in the second year the progeny that is grown from the plant selected the first year is carefully examined and another plant selected out, and this plant is continued in its selection so that the third year from the one special plant selected the second year we have 500 plants, and in the fourth year this gives us five acres, and the seed from this plat will be retained to plant the general crop the fifth year.

As a result of this careful selection the fiber has increased in length from about 1¾ inches to 2½ inches in the best strains, and the plants have at the same time been increased in productiveness. The custom of carefully selecting the seed has grown with the industry and may be said to be inseparable from it. It is only by such careful and continuous selection that the staple of these highly bred strains can be kept up to its present superiority.

One of the most striking instances of improvement in both length and abundance of fiber that has come under the writer's observation is a selection of Stamm Egyptian cotton conducted at Columbia, S. C. The few seeds of this variety imported had the lint attached as when taken from the boll, and the average length was only about 1¼ inches. (Compare original imported seed, plate II.) The plants of the first generation in this country were very tall, some of them reaching a height of eight feet, and very unproductive. Seed from several of the best plants, which were nevertheless inferior, was selected and preserved for planting the second season. The second season the lint from some of the plants was much longer, more abnndant, and of better quality than that from plants grown from imported seed. (Plate II, seeds marked first generation selection.) The progeny in the second year, grown from the first year's selection, were uniformly earlier, much more productive, and had longer and better lint. The lint on some plants was remarkably abundant and uniform, and in a number of instances reached the length of 1¾ inches. As a result of two years of careful selection in this country the character of the staple had thus been entirely changed and improved.

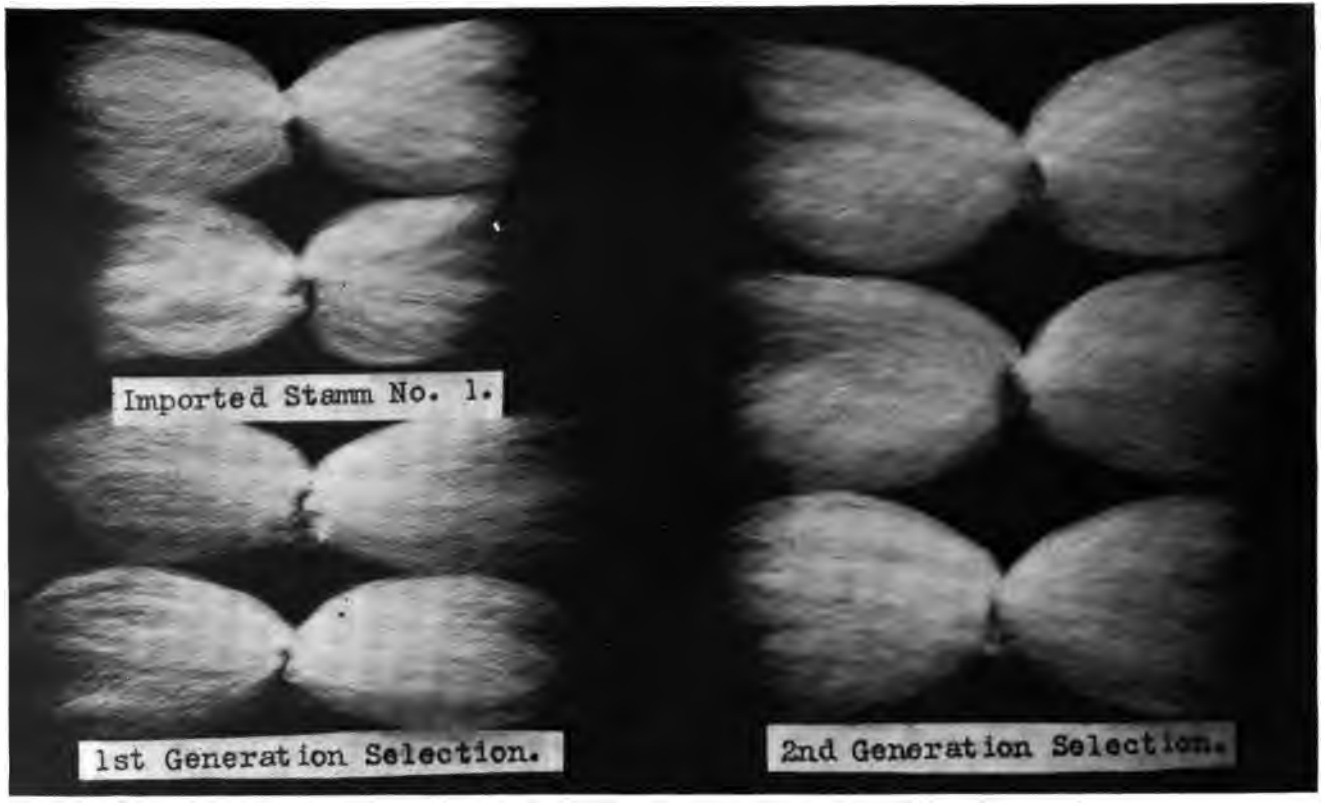

FIGURE 4. — Improvement of Stamm Egyptian cotton by selection.

PRODUCTION OF DISEASE-RESISTANT RACES.

Another important feature of the work of the Department is the production of disease-resisting races. I had the pleasure of calling this matter to the attention of the Association at the Washington meeting in October, 1900. One of the most serious diseases attacking the cotton plant is the so-called wilt or black-heart, a fungus disease which attacks the small fine roots and runs up into the stem and causes the plant to wither and die. Almost every plant in an entire field will be killed, and large areas of the very best Sea Island cotton land on Edisto and James Islands have been abandoned because of this disease. The same disease has spread all over South Carolina and Georgia, is very common in Alabama and is spreading on westward to some extent, attacking not only the Sea Island cotton but the Upland cotton also. In the results of the experiments with this disease we have one of the best illustrations known of the application of the science of breeding to the production of immune strains. As we look over a field of badly diseased cotton we see occasionally a plant standing up which has resisted the disease. We might suppose this to be due to accident; but by selecting seed from such resistant plants we find that it is possible to produce a strain which is almost absolutely immune to the cotton wilt. A resistant strain of SeaIsland of this sort was produced by Mr. E. L. RIVERS of James Island working in cooperation with the Department, and seed of this immune variety has been distributed in the Sea Island regions of Georgia and Florida the present season. Mr. W. A. ORTON, of the Department of Agriculture, who has been conducting the investigation of this problem, has also found that immune strains of Upland races can be produced in the same way, and such immune races are now being propagated for distribution next year.

GROWING EGYPTIAN COTTON IN THE UNITED STATES.

The importation of seed of the Standard Egyptian cotton varieties in the attempt to grow this cotton in America is still

another important line of cotton experimental work which the Department of Agriculture is pushing.

The experiments in the improvement and adaptation of Egyptian cotton have been going on for a number of years. The first importations of seed, so far as I am imformed, were made in the early '70s, when small quantities of seed was sent out all over the country, but they were too small to result in thorough tests and the results obtained were discouraging. Most growers were disgusted with the cotton because it did not produce well, and they had no means for handling it and no market for it when produced.

Still later the Department imported and distributed large quantities of this seed again. Fortunately one man in Texas, Mr. WENTWORTH, of whom some of you may have heard, became imbued with the idea that we might succeed in growing Egyptian cotton in that state, at least, and continued cultivating the strain — it happened to be Mit-Afifi — on a small scale for a number of years. He claims that a product can be produced here of a grade equivalent to the very best of the imported article. Mr. WENTWORTH sent three bales of his cotton, I believe, to the Boston market, but for some reason if we are correctly informed, they remained unsold.

The matter rested there, so far as we are informed until about four years ago when the Department took up the work again in an earnest endeavor to import this cotton and get the industry established. An importation of Jannovitch seed was made about five years ago and some of it was sent to South Carolina and some to Georgia, and in fact all over the country, but so far as we are informed only one test was made with it that really deserves mention. One plat of about six acres grown at Godwinsville, Ga., gave a fairly good yield, and manufacturing tests made by the Ponemah Mill, Taftsville, Connecticut, indicated that the staple was of good quality. The report was that the cotton was of good body and that there was a decidedly small amount of short stock and waste.

However, the matter still remained unsettled. All of these

cottons, when they are first imported, fail to come true to the type that the grower desires. They grow very tall and spreading, and very few bolls set. At first they produce very lightly and this is one of the general failures of all of the Egyptian varieties. We have tested Mit-Afifi, Ashmouni, Abbasi, Gordon Pasha, and Jannovitch, and practically every variety of Egyptian cotton grown; we have had the very best quality of seed that could be procured and have grown experimental fields in practically all of the Southern states. As a result of these experiments the conclusion has been reached, that if Egyptian cottons are to be made to succeed in this country, they must be carefully selected and new strains produced somewhat different from the imported, perhaps, which are better adapted to our conditions. This is the line of experimentation in which we have been engaged for the last three years. An experiment was started in one case with a strain of Ashmouni cotton, selected not because it was a particulary fine variety, but because of its earliness and greater productivity in the region of South Carolina, where the experiments were to be conducted. The first year the small yield was very discouraging. As a result, however, of three years' experimentation we obtained this year a yield of 443 pounds of lint per acre and a production of seed cotton of 1303 pounds. This is a larger yield than the majority of the Uplands produced in that vicinity. (Samples of the select American strain and imported fiber were exhibited.) A field of Mit-Afifi cotton was also grown at the same place and on the same soil from directly imported seed; and this yielded 960 pounds of seed cotton per acre. Mit-Afifi in Egypt gives a better yield ordinarily than Ashmouni. However, it is late and is rather unsuited to the conditions existing here, so that if Mit-Afifi is to succeed in giving us as large a yield here as the Ashmouni it must be carefully selected and improved, and I fully believe that this is possible.

We have grown Egyptian cottons in two-acre patches practically in all portions of the cotton belt this year and the year before. We have had two patches in South Carolina, two in Georgia, nine

patches of several varieties in Texas, two in Mississippi, one in Arizona, four in New Mexico, two in southern California, and one in Florida. When we first started in this line of experimentation we supposed that probably our best results with Egyptian sorts could be expected in some of the arid territories — Arizona, for instance, in the Colorado River valley, an irrigated valley, which we supposed was almost the same in soil and climatic conditions as the Nile valley where irrigation is regularly pursued and where the finest Egyptian cotton is grown. However, two of our agents, Mr. T. H. KEARNEY and Mr. THOS. MEANS, who visited Egypt last summer in connection with these experiments found on a careful comparsion of the Egyptian conditions with the conditions that exist in the United States, that the climate in Egypt where the best Egyptian cotton is produced is very similar to the climate of Eastern and Central Texas, Mississippi, Alabama, etc. That is, it is not altogether an arid country, as we had supposed, but has a moist, humid atmosphere. True, there is no rainfall, but there is moisture in the atmosphere and the water is added artificially to the soil by irrigation. Therefore, practically the same conditions exist there that we have in many of the Southern States, and our experimental evidence has upheld this conclusion. The best results have been obtained in Eastern and rather moist regions. In Arizona and Southern California where the atmosphere is exceedingly dry and where irrigation must be practiced unceasingly, we notice that the bolls shrivel up and do not open very well. They seem to open prematurely before the cotton is fully developed, and the yield is very much smaller. So that instead of getting our best results with Egyptian cotton in the extreme West, we are now inclined to think that our best results will come from cultivations in the East.

What I want to do here, gentlemen, is simply to inlist your sympathies in this Egyptian cotton question. It has been said too long that we cannot grow Egyptian cotton in this country. My sense of patriotism, if nothing else, would deny this and I think that the experimental evidence is sufficiently conclusive now,

so that we can say with some degree of certainty that we can produce a good yielding cotton of as good spinning qualities as the imported article.

I have samples of several of those cottons grown in this country on exhibition and I hope that any one here who is familiar with Egyptian cotton will carefully compare them and give us the benefit of his criticism. If any of you are interested in the matter particularly, we will send you samples of sufficient size, so that you can determine what they are. As I said in the beginning, you are the judges in regard to this cotton. If it possesses the desired qualities it must not come to the market and remain unsold. That is a condition that will kill all attempts at cultivation and destroy a budding industry. If the cotton is of fair quality, if it is worthy of spinning and is produced in this country, give it your sympathy; go a little bit out of your way, if you will, to further the industry. I feel perfectly convinced that if we can enlist your sympathy and retain the interest of the growers — and the growers are becoming interested in this matter — we can certainly produce here the $10,000,000 worth of this Egyptian cotton annually which we are importing at the present time. I thank you for your attention. [Applause.]

The PRESIDENT. Gentlemen, you have listened to an extremely valuable paper by Dr. WEBBER. He seems to have covered the subject thoroughly. There may be some questions; if so, Dr. WEBBER will be glad to answer them. If not, we will pass along, as time is somewhat limited, to the reading of the next paper, Improved Ginning, by CHARLES J. MCPHERSON of South Framingham, Mass.

*IMPROVED GINNING.

CHARLES J. MCPHERSON, South Framingham, Mass.

Gentlemen of the New England Cotton Manufacturers Association: It affords me pleasure to come before you to-day, at your kind invitation, as the representative of the American Cotton Improvement Company, which is the owner of the new rotary roller cotton gin, about which I am to speak to-day. Several of your members have already witnessed the operation of our machine, and have been pleased to join our company in its work of improving the cotton staple. I mention this fact to you so that you may know the character of the men who purpose to aid in the great improvement of the cotton staple, in which you are all so vitally interested.

The issue was long ago raised, however, that the saw gin is more or less destructive of the value of the cotton fibre which it gins. This objection to the work of the saw gins was raised by the men who knew the most about what they were talking, the men who had used the fibre in the various lines of manufacture, especially the spinners.

Scientific men made analyses, and reported that the work of

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* For further references on this subject see Transactions as follows: Vol. 22, p. 48, FREDERICK A. LEIGH, McCarthy Gin; Vol. 23, p. 6, D. S. SKINNER, Ginning of Cotton; Vol. 23, p. 25, FREDERICK A. LEIGH, Roller Gin; Vol. 31, p. 27, RICHARD GARSED, Ginning Cotton; Vol. 35, p. 89, THOMAS PRAY, Jr., Saw Gin; Vol. 47, p. 28, EDWARD ATKINSON, Bow Gin; Vol. 59, p. 207, D. A. TOMPKINS, Baling of Cotton; Vol. 59, p. 226, EDWARD W. THOMAS, Disadvantages of Poor Ginning; Vol. 64, p. 128, THOMAS W. PRIOR, The Roller Gin; Vol. 66. p. 400, E. W. ATKINSON, Roller Ginning; Vol. 66, p. 410, R. DERDEYN, Cotton Ginning; Vol. 72, p. 99, S. N. D. NORTH, Monograph on Cotton Ginning.

the saw gin was wasteful, damaging and murderous to the delicate cotton fibre. Then again it has been the custom to work in more or less sand and dirt, which has to be paid for as good cotton. Although you cannot always see it, it is there just the same, and amounts to a very considerable figure. Then the item of card waste is a considerable one, and had the cotton been ginned on the roller gin, it would have been mostly eliminated.

It is the object of the American Cotton Improvement Company to prepare at the Southern ginneries a staple as perfect as it is possible to make it; a staple that will be worth to you millions of dollars in excess of its present worth, and at no extra cost of preparation. Can our company do this? Many practical cotton men who have witnessed the operation of our machine and its product, assure us that we can do so beyond question.

Last year we gave an exhibition of our machine at Vicksburg, Miss., at which a score of cotton men were present. Writing of the work of the machine at that time, Messrs. W. C. Craig & Co. of that city, who, while heavily interested in saw ginning themselves, are nevertheless broad minded gentlemen who desire the improvement of the cotton staple, and recognize the great value of roller ginned cotton, said:

"In the presence of about twenty gentlemen connected with the cotton business, as planters, ginners, buyers, factors, etc., an exhibition of the working of the new roller cotton gin belonging to the American Cotton Improvement Company, and in charge of Mr. C. J. McPHERSON, was this day given at the ginnery of The Advance Gin and Mill Company of this city. The object was to show the quality of the work and the quantity of the output of this new roller gin.

The roller gin was set up with no adequate feed or condenser delivery, and for purposes of comparison a certain amount of seed cotton was weighed out for the roller gin and a certain amount for the Eagle 80 saw gin stands, these latter being among the very best in the South. The roller gin has two ginning rolls,

one of which was hastily made here and it was perfectly apparent to all that it was not doing the amount of work done by its companion roll which came from the company's shops, and for about fifteen minutes this roll was shut off altogether.

It was demonstrated, however, that the roller gin turned out practically or actually as much lint cotton in the same time as did the 80 saw gin, and it was admitted by all that the seed from the roller gin was the cleanest ginned, while the lint was full length, uncut and unbroken. The cotton ginned was of the Allen staple variety with a fibre of $1\frac{8}{8}$ to $1\frac{7}{16}$ in. and a large white seed to which the fibre adheres tenaciously. It is admittedly one of the hardest varieties of cotton to gin upon any gin.

The test, as stated above, was held at the Advance Gin and Mill Company's plant in this city, which is regarded by all as one of the very best outfits for ginning cotton to be found in the cotton belt. Its saw gin was in perfect condition for ginning at the time the test was made, while on the other hand the roller gin had only recently been installed, with an improvised feeder for delivering the cotton to the gin, and altogether was not surrounded by as favorable conditions as the saw gin.

At the end of the test, when both the lint cotton and cotton seed were weighed, it was demonstrated that the roller gin had shown its capacity and ginned as much cotton per hour as the 80 saw Eagle gin stand, and that it cleaned the seed equally as well, if not better, than the saw gin and without injury to the fibre of the cotton."

You will pardon me for quoting to some extent from the records of your own Association, in which I find an accumulation of testimony in this direction, some of which I will quote in order to bring out somewhat fully the consensus of opinion upon this point, viz., the great demand for improvement in ginning.

In an admirable article upon cotton in September of 1895, the *St. Louis Republic* spoke of the "Loss in the initial strength of the fibre by the destructive processes of the saw gin."

In October of the same year the *Atlanta Constitution* printed an able address upon cotton matters by Mr. JEROME HILL of

St. Louis, now of Memphis, one of the best known cotton men of the South and a member of this Association, in which he said:

"The Whitney (saw) gin has, in my opinion, served its purpose, and I now believe it will soon pass and be succeeded by new and improved inventions. In fact, I agree with Mr. EDWARD ATKINSON, that the saw gin should be laid aside and that improved methods should be used for taking the lint from the seed without cutting or destroying the fibre. At least this can and will be done. I have noticed that when man's mind is directed toward a desired improvement his genius is equal to the wants of man, and in turn the Yankee's perseverance overcomes all obstacles."

Mr. EDWARD ATKINSON of Boston said in an address at Atlanta in 1895, before the cotton manufacturers: "The result of our maltreatment of the cotton fibre on the way from the field to the finished cloth, is to deprive the fibre of about seventy-five per cent. of its initial strength. * * * The whole margin of profit in all our modern arts consists in saving the waste. * * Of all bad and wasteful processes which now prevail in our work, the very worst are to be found in the treatment of the cotton fibre from the field to the factory. * *. * We take three-quarters of the life out of our cotton by our murderous method of treating it. * * * You mangle your long staple on a saw gin. * * * Why not use the roller gin as they choose to do in Egypt because the use of the saw gin on Egyptian cotton would impair its value one-quarter or one-third"?

Previous to that time Mr. ATKINSON, in talking before your Association, said: "Nobody can consider the ginning of cotton without seeing that it is, as now conducted, an utterly barbarous method. The ginning branch of the work is that in which the greatest injury is done." At the same meeting Mr. GARSED of Philadelphia said: "I hope that some arrangement will be made * * * so that we can exercise the same skill in ginning cotton that we do in manufacturing cotton." Mr. LEIGH, another well known cotton man, said: "I feel sure that the most impor-

tant point in the preparation of cotton is the ginning. That is the way it is damaged."

In an intelligent article upon the cotton industry, *The Wisconsin Engineer* said: "As the progressive methods of the 19th century have but just begun to invade this industry, after nearly a century of stagnation, it is fair to presume that other improvements will be made, especially in the ginning of cotton."

THOMAS W. PRIOR of Philadelphia, who has given much study to cotton ginning, says, referring to the saw gins in use today: "A method of ginning which robs the staple of half its life before it reaches the spinner, and no one better than the spinner can appreciate the deadly action of the saw gin upon the sensitive cotton fibres. * * * Not only does the saw gin destroy much of the life of the cotton, but with its 'motes' and 'picker waste' loses to the planter and mill owner fully six per cent. of every bale of cotton ginned. * * * The mill owners are ready to adopt any method tending to better the quality of the cotton, while the grower is anxious to increase the value of his staple; and a gin that not only preserves the fibre, but will handle the same amount of cotton as the saw gins, and reduce the general waste to a minimum, will ultimately be a portion of the equipment of every cotton plant and ginnery in the country."

Speaking further along these lines Mr. ATKINSON says: "The theory of the roller gin must prevail. The saw gin must be invented out of existence. The improvement of cotton is now in the air." He characterized the ginning and handling of the cotton fibre before it gets to the manufacturer as "The most important department of cotton manufacturing that there is in existence." The saw gin is not only chargeable with the injury which it does to the staple in the process, but is chargeable with all the subsequent injury of trying to get the entrapped air out which that gin puts in. * * * The only merit of the saw gin has been quantity rather than quality. The injury has been in the quality. If we can bring the roller gin up in quantity, the quality will be so much better that the saw gin will die

out. * * * It is proved that the maximum of injury by the application of mechanism to the cotton fibre is done by the saw gin. * * * When the cotton is taken from the seed by the roller gin it is drawn off substantially in parallel lines."

Speaking before this Association in 1898, Mr. JOSEPH M. DUNHAM, one of your number, said: "The experience I have had in handling cotton has taught me that the most necessary point is as to the length of the cotton."

At the same meeting Hon. W. C. LOVERING, the well-known cotton manufacturer and congressmen of Taunton, Mass., said: "We must exact from the South perfect staple in perfect form and in an advanced stage of preparation. The ultimate result will be that the manufacturers will really get cheaper cotton and the planter will get more for his cotton. * * * Until you get a perfect gin that removes all the seeds you have got to stick to your picker."

At a meeting of this Association in 1899, Mr. D. C. BALL of New York, then manager of the American Cotton Co. of that city, said in an address: "I think there is a *tremendous advance in ginning impending;* we have not touched it yet. * * * With the improvement in the ginning there will come the cleaning of the cotton right in the fluffy lint, the best place to clean it, as you have told me and as we have found by experience."

In October, 1899, Mr. M. F. FOSTER of Milford, N. H., addressing your honorable body upon the topic of ELI WHITNEY and his Cotton Gin concluded his remarks in these words: "We draw a veil over the imperfections of the saw gin, and as cheerfully as the conditions justify, accept the mutilated staple, and rejoice that we have even that to be thankful for. But new times demand new measures and *every cotton manufacturer will hail with delight the introduction of a machine* which will overcome the objectionable features of the present system of ginning cotton."

The president of this Association, Mr. STEPHEN A. KNIGHT of Providence, at the same meeting, said: "I think it has been

a source of very much annoyance during the past year, the bad manner in which cotton has been ginned."

At the same meeting, Mr. J. E. CHEESMAN of New York, speaking upon the difference between saw ginned and roller ginned cotton, said: "A practical test has been made on the same grade of cotton ginned by the most improved saw gins now running and the experts — the buyers, the practical men — have in several cases given *from one-half to two and three cents a pound more* for the staples of the roller gin cotton over the saw gin cotton."

In an interview in the *Boston Herald*, Mr. EDWARD ATKINSON said: "I have always believed that some inventor would ultimately develop a roller gin which would equal the saw gin in quantity and beat it all to pieces in quality. * * * Manifestly, our delicate fibre, although very strong, is liable to be cut, broken and even crushed in the various processes by which it is passed from the field to the factory. *The greatest injury is done by the saw gin.*" In a recent address at Atlanta, Mr. EDWARD ATKINSON showed that in seventeen years the waste to the Southern people by bad ginning and preparation of their cotton, figured at only a cent a pound, amounted to $600,000,000. "The true place in which to clean the cotton and prepare it is at the ginnery. The advantage of the roller gin not only consists in avoiding the injury of the saw teeth, but the roller gin draws the fibres from the cotton seed in parallel directions. * * * If the present bad work in the cotton ginneries of the South is well and rightly done, there will be much less bad work to undo after the bale of cotton reaches the mill." Speaking of the attempt to improve the cotton plant itself, and its cultivation, the selection of the best seed, etc., he says. "Very great progress has been made, especially in the development of long stapled cotton which may take the place or even be better for many purposes than Egyptian cotton, but *up to this date all cotton has been mangled in the saw gin.*"

Prof. CHARLES L. NORTON of the Massachusetts Institute of Technology has made some very fine and exhaustive tests upon

cotton fibres, relative to their loss of strength when subjected to the various processes. He says: "Coming next to the saw gin, we find considerable damage to the fibre. * * * Some saw ginned cotton samples show fibres which have lost 10 per cent. of their average strength in ginning and others 25 per cent. * * * The roller gin causes no such diminution in tensile strength, and in some cases I was surprised to find the average strength after ginning on a roller gin was a little higher than before." Concluding his lecture, after bringing those points out with considerable fullness, he said: "To repeat, then, I believe we have shown, first, that the cotton fibre is *damaged in saw ginning from 10 to 25 per cent.*, and is, moreover, somewhat broken into short pieces, and that the roller gin, while it *may* break up the fibres, does not sensibly lower their average strength." Speaking of the fibres he tested, he said: "I have found some fifty such [broken] fibres in saw ginned cotton, and only one in cotton which had not been saw ginned."

Mr. E. W. ATKINSON of Boston, in an address before this Association, referring to the Egyptian ginneries which he had visited, said: "They have been tempted by the large output of the saw gin to experiment with it, but have *invariably thrown it aside on account of the great injury it does to the cotton fibre.* * * * As long as the saw gin is universally used for our staple cottons, there is very little encouragement to the planter to do much in the way of improving." Mr. ATKINSON told of a trial by one of the best ginners in the South of a roller gin and one of the best makes of saw gins. The seed cotton for the test was taken for each kind of gin out of the same pile, and after it was ginned about fifty sets of samples were sent out to as many experts for their valuation of the cotton. The replies showed that *in no case* was the value of the roller ginned sample placed at *less than one cent per pound in advance* of the value of the saw gin sample, and you may be surprised to hear that *in some cases a difference was placed as high as four cents.* The bales were tested in one of our New England mills. * * * The roller gin cotton carded much better, made a stronger yarn, with less

waste." Another set of samples was sent to England, "With the same results as before. *The roller gin was pronounced to to have a longer staple, yielded less waste in its work, carded better, and handled better throughout the machinery, and finally made a more lustrous, stronger and better yarn.*"

Mr. R. DERDEYN of Vicksburg, Miss., one of the leading cotton ginners of the South, says: "The delicate operation of separating the seed from the lint cotton, in fact, the first and most important process of manufacturing cotton, goes on in the most barbarous, careless way it is possible to imagine."

Mr. C. P. BROOKS, Director of the New Bedford Textile School, says: "There is no doubt that the roller gin separates fibre from seed with very much less damage than in the case of the saw gin."

These are but a few of the thousands of testimonies to the same end and effect. It is not surprising then that good mechanics have tackled the problem, and that during the last few years various attempts have been made to build gins upon the roller principle. These gins, however, have adhered to the reciprocating movements, and have consequently failed to make much advance upon the older roller gins in point of quantity of output.

The writer and his associates are among the number who for several years past have made this matter a subject for study and experiment, having built several machines during that time, and secured patents upon the broadest lines. We are now prepared to show a perfect machine that combines among many advantages the two essential ones of the best quality of work, and as much of it as any saw gin can do, with less power employed and absolute immunity from fire. Our theory has been that the cotton should be cleaned before being ginned, instead of afterwards, and so our machine very effectively cleans the sand, dirt and motes from the cotton, and then gins it in perfect form. Experts who have examined its work say that not only is the lint a perfect staple, but it cleans the seed better than any saw gin does.

It is well-known that the saw gins are uninsurable, because of their liability to strike fire by the contact of the saw with the breast, or because of their striking stones or iron that may get into the cotton; or if insurable, the premium is so high as to be almost prohibitive. Our machine, however, not only cannot strike fire in any way, but the operation of our rolls is to immediately smother out a fire, could one in any way be started. This we have demonstrated before the fire insurance underwriters by feeding matches into the machine, and indeed by purposely setting the cotton afire to show how it was instantaneously smothered through the operation of our rapidly revolving rolls.

The feeder and cleaner effectually removes all sand, dirt and motes before the seed cotton strikes the ginning rolls, and it is therefore freed from a large amount of waste matter which you, gentlemen, are accustomed to pay for at high prices.

This machine is built upon the rotary principle, runs smoothly and without vibration. It is not a large machine, measuring but about 28 inches in depth from front to rear, about three feet high to the top of the rolls, not including the feed hopper, a little more than six feet over all in width. Our power indicator shows that it takes only six or seven horse power to run it, and its construction and operation are so simple that no high grade of skill is required. We simply use ginning rolls, preferably of felt, which are very easy on the cotton fibre, and which by gentle friction against a polished blade of steel pull the lint through the machine, while our rotary comb rollers disengage the seed from the lint, ensuring gentle treatment of the fibre, while at the same time the smooth, rapid movement of the ginning and comb rolls results in a very large output, as much, at least, as the largest size saw gin.

It is needless for me to tell the practical men of this Association the need of better ginned cotton. You know it and appreciate it more than anybody else. I might talk here all day, and not prove it so effectively and quickly as I can by extending an invitation, which I take pleasure in doing, to all of you, to come down to 161 High street, the offices of the American Cotton

THE ROTARY ROLLER COTTON GIN.

Improvement Company, and see for yourselves the quality of the lint, and the quantity of the output, which means more money for you, gentlemen, than for anybody else, and which will enable you to make a new standard for cotton goods throughout the world.

The PRESIDENT. I understand that Mr. ABRAHAMS has some samples of ginned cotton which he would like to show.

Mr. I. ABRAHAMS. I simply wished to state that this is the seed cotton and this is the cotton ginned (exhibiting samples) yesterday on a Huckaby roller gin.

The PRESIDENT. Your attention is called to the samples of seed cotton and the cotton as it is ginned on the Huckaby machine. It will remain here on exhibition for the inspection of the members.

We will now proceed with the reading of the next paper, Current Theories of Dyeing, by JOHN W. FRIES, Winston-Salem, North Carolina.

*CURRENT THEORIES OF DYEING.

JOHN W. FRIES, Winston-Salem, N. C.

Until comparatively recent times, dyeing was a purely empirical art, often transmitted as a sort of family legacy, with secret recipes, and doubtless there are some here besides myself who remember the last survivors of the olden times, travelling dyers, often shabbily dressed, and oftener drunk, their entire equipment consisting of a bundle of dirty, worn receipts tucked away in their coat pockets.

When I wrote that paragraph, gentlemen, I thought the breed had died out, but I accidently found one in New York City last Monday. If we only had a museum connected with this Association I could probably supply him.

Chemistry came, a wonderful revolution, smashing the crystalized ignorance of ages, big with possibilities, and in the rash consciousness of these possibilities formulating theories which were to explain all phenomena occurring in all forms of matter. And thus the early chemists formulated the theory that all the results in dyeing were to be explained by Chemical Affinity.

As the years rolled by and it appeared that Chemical Affinity did not always explain satisfactorily, there came another, the Mechanical Theory, whose advocates claim that the dye is attached to the fibre by physical attraction, and since this theory

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* For further references on this subject see Transactions as follows: Vol. 43, p. 79, GEORGE ASHWORTH, Dyeing Cotton; Vol. 60, p. 143, TH. OTTO SCHWEITZER, Turkey Red Dyeing; Vol. 70, p. 318, F. J. MUIR, Troubles to Manufacturers Arising from Dyed Yarns; Vol. 71, p. 205, HENRY G. KITTREDGE, Dyeing of Cotton.

failed to explain everything, some one later suggested the Solid Solution Theory.

In the effort to fit facts to theories, some one has made the tentative proposition that the Chemical Theory may be applied to animal fibres, and the Mechanical Theory to the vegetable; but there appear to be no general reasons for such a distinction, and since we are met as cotton manufacturers there is no call to trouble ourselves with anything but cotton.

It may be stated with confidence that the Chemical Theory is faulty, because the cellulose, a substance of known composition and atomic weight, is not known to combine in definite proportion with any dye stuff, and in fact remains chemically unchanged in all ordinary dyeing operations. When there is a chemical change in the cellulose it is likely to be destructive, as with strong sulphuric or muriatic acid, or to render the fibre unfit for textiles, as in the case of gun cotton; and hence, speaking generally, the colorist seeks rather to avoid than to promote any chemical action on the fibre.

The Mechanical Theory satisfactorily accounts for the deposit of coloring matter in or upon the unchanged cellulose of the fibre, or at least we may accept it as a name for a considerable number of well recognized facts in every-day practice. But it is quite a one-sided view of the phenomena of dyeing, for undoubtedly there is and must be a chemical change in many dyestuffs, even if there is no change in the cellulose.

The Solid Solution Theory seems to be simply a name for the fact that cotton is a porous substance which can be wetted; that when once saturated it retains a certain amount of water which cannot be removed by wringing or pressure, but only by evaporation. Glass can be painted, but cannot be dyed, because it can be wetted only superficially; so, too, cotton saturated with oil cannot be dyed satisfactorily, because the ordinary dye bath cannot then penetrate the fibre. If it were practical to use solutions of dyestuffs in oil, we could easily color any greasy cotton, but the cost restricts us to aqueous solutions.

In coloring, the water has dissolved the dyestuff and the solu-

tion wets the cotton, or if the cotton has been "boiled out" before immersion in the solution, then the color passes into the fibre by diffusion. This diffusion process is very slow and irregular if the yarn be simply immersed in the bath, and handling is necessary for the saving of time and to secure anything like uniformity. After sufficient handling, the surplus water is removed by wringing, squeeze rolls, or hydro-extractor, the remaining water evaporated, and the non-volatile dyestuff remains in and upon the fibre. If salt be used in the dye solution, it promotes diffusion of the dye into the clear water with which the yarn had been wetted; probably the diffusion of the dye is more rapid than the diffusion of the salt, and as clear water dissolves dye more readily than salt water, there is a concentration and precipitation of the dye in and upon the fibre, which would account for the partial exhaustion of some of the dye solutions. Further, it is a well recognized fact that matter on the point of precipitation, or in very fine state of suspension, tends to attach itself to near-by solids, as is commonly seen on roots and twigs in apparently clear streams, or in those flowing from chalybeate or saline springs. Probably the salt colors are deposited in somewhat the same way, and these salt colors furnish the simplest method of dyeing, with no chemical questions involved. It is merely a matter of saturation of the fibre with a solution of dye.

The ordinary boiling out of the yarn and the subsequent steeping or boiling in the dye solution, simply serve to expel the air from the yarn and wet it through and through. Under uniform conditions, a certain quantity of water will wet a certain quantity of yarn. The old time expression was "pound for pound", because hank yarn roughly wrung out by hand weighs approximately twice as much as the dry yarn. But if the yarn be hydro-extracted, or passed through good squeeze rolls, one pound of water will remain in only about 1½ pounds of yarn. The tint or shade will be directly proportionate to the amount of color dissolved in a given quantity of water, but as the object usually is to get a deeper shade and partially exhaust the bath,

it is common practice to add sodium chloride or sodium sulphate to the bath. These salts are called "assistants", but the only way in which they "assist" is to reduce the solubility of the dye and promote precipitation. It is possible to "salt out" all the color and thus exhaust the bath entirely, but then the color is precipitated in such gross form as to be largely superficial, and hence much less salt must be used in practical work. The final shade is the resultant of a number of uncertain factors: the dilution of the bath, the content of salt, the temperature, the time given, and above all, the care and judgment of the dyer. Colors of this class all "bleed" more or less, because there is no chemical change either in the cellulose or the dyestuff, as they are generally applied, but they may be somewhat improved by steaming or by topping with blue stone or bichromate.

A beautifully simple case of chemical action is the old-fashioned "nankeen". Here the cotton is simply saturated with a solution of an iron salt, and the soluble iron converted into the insoluble oxide. The reduction of indigo is a somewhat difficult and delicate operation, but given the reduced solution, the dyeing with indigo consists of simply saturating the cotton with the reduced solution and then converting the indigo to its insoluble form again by oxidation. The sulphur dyes are still too new for generalization, but they seem to fall into line with indigo; the color is dissolved by reduction, the cotton saturated with the solution, and the dye fixed by oxidation.

There may be chemical affinity between cellulose and certain vegetable products containing tannin, *e. g.*, cutch and sumac. The fine results obtained with cutch, and the fact that cotton takes up pretty definite quantities of tannin under known conditions, would indicate that this is the fact, but so far as I know, chemists have not demonstrated that there is any molecular change in the cellulose, or any new combination formed. However this may be, tannin is the foundation for basic colors and definitely precipitates these colors from their solutions, but these precipitates are not insoluble unless further treated with antimony or otherwise.

Years ago I conceived the idea that it was irrational, especially in the case of direct dyes, to reckon the weight of dyestuffs as so much per cent. on the weight of the material to be dyed, and then to dissolve them in a random quantity of water, with more or less of common salt or Glauber's salt. This process is the more irrational because the yarn has been previously wetted out and is consequently *full* of clear water, which has to be displaced before the dye can reach the very heart of the fibre, or else this clear water has to be brought into the condition of a dye solution by diffusion or otherwise. To do all this necessarily requires much time or handling, or both, and both time and labor are costly. When this idea had once been clearly grasped, the better way presented itself almost as a matter of course, but the development was gradual, too, as the elaboration of such ideas is usually a growth.

First. The dyestuff should always be reckoned as a percentage of the *liquid*, and then the solution needed for any particular shade can always be duplicated with accuracy. Of course the quantity of solution prepared would be with reference to the quantity of material to be treated.

Second. The dye solution should always be applied to *dry* yarn, so as to get on to and into the yarn *at once* just as much water as will wet it and no more, and this water should have just as much color in solution as will give the desired shade and no more. Then by passing the yarn into a solution of known concentration, at uniform speed, between rollers under constant pressure, we get uniformity of shade not otherwise attainable. If the yarn can also be dried in the same operation, we have eliminated all manipulation and reduced the cost to the minimum.

These are the fundamental ideas on which my work has been done, and they are so different from traditional practice as to be simply revolutionary. To work out a practical application of them, I have had to lay aside many an old-fashioned idea which was so familiar as to seem an axiom, and to overcome many practical difficulties, some serious and others trifling but trouble-

some. These results have been fully protected by patents in this country and abroad.

The sizing of warp yarn is as old as our industry, but the slasher made the continuous sizing, drying and beaming possible. Printing by hand is very old, but calico could never have been produced cheaply in large quantities without the engraved roller. Equally as radical an improvement is my method, which takes the dry yarn for warp or filling direct from the ball or beam, and without any handling whatever delivers it dry again. It has been suggested that I should further arrange the machinery to beam or quill this yarn in the same operation, but as yet I have thought that the greater complication would offset the advantage. It is merely a matter of mechanical construction to color piece goods just as I am now coloring the chain.

What I have accomplished has been done in the time I could snatch from an otherwise busy life, and in the face of a good deal of annoying, but perhaps natural, skepticism and opposition. That, however, is in the past, and I am now coming into the enjoyment of a great deal of kindly sympathy and help, which I desire thus publicly to acknowledge. I recognize that the full measure of what shall be done on these new lines will be due to the originality and ability of expert dyers and technical chemists. There is a constant succession of new products from the chemical laboratories and constant improvement in the application of dyes, all of which will add to the scope of the work which may be done on my machines and will afford an ample field for our united effort.

The PRESIDENT. If there is no discussion desired we will proceed to the reading of the next paper, Gray Goods for White Lawn Work, by DANIEL MOORE BATES, Wilmington, Del.

*GRAY GOODS FOR WHITE LAWN WORK.

DANIEL MOORE BATES, Wilmington, Del.

First a summary of the process for finishing white lawns.

The gray goods are well singed on both sides to give a clean, sheer surface. They are then thoroughly bleached, tinted and starched, framed, and, if a smooth finish is desired, calendered. The framing consists in drying and "scrimping" or tentering the cloth on a tenter-frame. If you hold a small piece of cloth between your hands, grasping it at the ends of the filling threads, and work one hand up as you work the other down, you get a good idea of the scrimping motion. Its object is to work the filling threads loose from the warp threads, where the two cross in the weave, thus preventing the starch from sticking them together as it dries. This scrimping is what gives lawns their elastic, springy "feel."

I want to draw your attention especially to these points of the process. In singeing, the goods must be singed close and the singe-plates, therefore, must be at a bright heat. The bleaching must be thorough to cleanse the goods for whites. In framing, the goods are held by the clips of the tenter-frame only along the selvedges and must be stretched tight in width to get the proper "scrimp" and finish. Moreover, when the frame is once set, it is adapted to take goods of one width only. I will refer again to these points.

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* For further references on this subject see Transactions as follows: Vol. 65, p. 258, STEPHEN N. BOURNE, Packing Goods for Print Works and Bleacheries; Vol. 65, p. 259, STEPHEN A. KNIGHT, Packing Goods for Bleacheries; Vol. 66, p. 226, D. M. BATES, Gray Goods from the Bleacher's and Finisher's Point of View; Vol. 73, p. 258, A. C. FREEMAN, Bleaching and Finishing of Textile Fabrics.

To go back to the gray goods for white lawn work. In the first place they must be clean. Bleaching will remove much in the way of dirt, grease and stains, but not everything. Its proper function is by boiling to remove the waxes and resins of the cotton fibre and the warp size, thus freeing and opening up the fibre, and then by the chemical action of the bleaching agent to decolorize what remains. For white work it is difficult if not impracticable to satisfactorily bleach out of the gray goods:

Oil in the yarn from spinning,
Grease and yellow oil spots from weaving,
Bale marks from dirt in transportation.

Oil in the yarn from spinning comes from many causes. It comes directly from oily top-rolls, indirectly from oily bobbins from the fly-frames and intermediates in the card room. These bobbins become saturated with oil from the spindles of the flyers and thus oil the roving wound upon them. Oily threads and lumps are also spun into the yarn from the dirty, oily fly which collects around a spinning frame. Without entering further into the variety of causes of oil in yarn, suffice it to say that all of this oil is most difficult to remove. Soaping before bleaching is sometimes effective, and a solution of carbon tetra-chloride is helpful on the finished goods, but where the oily yarn appears in any quantity the goods, if finished for whites, are fit only for seconds. During the past season we have had considerable trouble in this respect with some foreign gray goods imported for finishing. The trouble is evidently a universal one and its limitation varies with the amount of oversight and care exercised in the mill.

Grease and oil from weaving come largely from three things, dirty oil thrown from the cams of the loom, "cam-spatters," black grease on the selvedges from the winding-up of the cloth-roll, and yellow oil spots or oily filling threads from oil dropping off lines of shafting above the looms upon the warp-beams or into the filling boxes. Overhead shafting in a weave-room is not desirable, but, if unavoidable, it should have particularly

regular and careful attention. The oiling of the parts around the cams of the loom should also be looked to. Another matter connected with the weaving is the marking of the cuts. This should not be done with black lead or graphite, which will not bleach out.

From transportation a common trouble is what we call "bale marks," places where the grime and dirt of travel have been ground into the edges of the folds of pieces in bales not completely covered with burlap. Many bales have good coverings over top and bottom which extend down the sides and ends, but not far enough to meet and fully protect the goods. A space is left exposed where the greasy, sticky dirt around wharves and freight cars has free access to the cloth. Other bales have coverings over top and bottom which afford no protection whatever to the sides and ends, leaving them entirely open. These bale marks, often not noticeable in gray goods, do not fully bleach out. They show up clearly in finished white lawns as thin black marks running across the piece, usually repeating every two yards. Too much emphasis cannot be put on the importance of completely covering high class gray goods before shipping.

When the bales are opened up and the pieces laid out to go into process, the piece ends are sewed together, making a continuous length of several thousand yards to be run over the singe-plates and through the bleach house. But to make this length continuous, it is essential that each gray piece as folded up at the mill, shall in itself be one continuous, unbroken length. Sometimes gray pieces from the bale are made up of two or three parts. The "blind ends" folded into the piece are not discovered till the lot is being run down over the singe-plates, too late to catch them, causing bad singeing on the loose ends, loss of yards from piecing up, and much loss of time. Handsewings in the gray pieces are even worse, as they invariably break off and are apt to cause a "windup" in the machines. Floats where there is no filling yarn, sometimes a yard or more in length, are found in the middle of some pieces. They cause

the same trouble. All such pieces should be cut out, and each folded piece of gray goods from the bale, whether invoiced as firsts or seconds, should consist of but one unbroken length free from serious imperfections which might cause the cloth to part in process. Stress is laid on this point in connection with lawn work because a loss from a break-down in singeing goods of this grade is expensive.

The finer the grade of lawns, the more sheer and clean the finish demanded on the surface of the goods. As already stated, the cloth must be singed close, the singe-plates must be at a bright heat. Most important is it, then, that the warp of the cloth shall be free from chemicals which, called into energetic action by the heat, are extremely deleterious to the strength of the cotton fibre. This matter of warp sizing in connection with its effect on singeing gray cloths, is treated at some length in a previous paper on "Gray Goods from the Bleacher's and Finisher's Point of View." *All the remarks there apply with special force to the sizing of warps for fine lawns, mulls and organdies. If the lawns are weakened by action of chemicals during singeing, they will be ill prepared to stand the thorough bleaching to which they must next be subjected.

The last process closely related to the condition of the gray cloth is the framing on the tenter-frames, already described. In the first place the selvedges, by which the cloth is held in the clips of the frame, must be thoroughly sound and in good condition. In weaving, these may be nicked or damaged by the temples or in the winding-up of the cloth-roll, the latter as already explained being also the cause of grease along the selvedges. Unprotected bales, such as described, are frequently damaged in transportation on the selvedges of the goods by breaks and tears, and often by acid from carboys previously carried in the same cars. Any of these weakened selvedges which may survive the strain of bleaching, are sure to go to pieces on the tenter-frames under the vigorous action of the

* Transactions New England Cotton Manufacturers' Association, Vol. 66, p. 226.

scrimping motion. Breaks here will run clear across the piece, causing short lengths and sometimes additional loss where the damaged cloth necessitates stopping the frame, which spoils the thirty yards that it holds.

For similar reasons it is clear that any unevenness in width will give trouble, for the frame being set to finish the goods a certain width, the invoiced gray width for example, will pull a piece till it breaks if it does not give the usual stretch. Hence care at the mill should be taken to see that in baling, no odd width pieces are mixed into a bale, and in weaving that the spread of the temples and the tension on the warps are approximately uniform on all looms weaving the same grade of cloth.

I was much interested in this connection by Gen. DRAPER'S remarks this morning on the change in the position of the cloth roll on the loom, putting it up where the old breast beam used to be. It seemed to me if a change of this sort could be made in the old looms which were still used for weaving lawns, that a great improvement might be made by overcoming the variation in width of an inch or more, which often causes in the framing serious loss where we try to stretch the goods to the usual gray width and thereby break the selvedges, cause breakdowns on the frame and any amount of damage. And this width, which varies in the gray goods with the tension on the loom and the stretch to which the cloth is put from the breast beam to where it wound on the roll, is something which you cannot detect where you open out the goods for work, because it often appears in only one part of the cut. Part of the cut laid out and examined may be the end which rolled up easily without too much pull; but where the winding up motion of the cloth roll is stiff it may increase this tension and make one end of the cut very narrow, and thus cause this damage, this breakdown on the lawn frame, to which I refer.

A defect from weaving which is largely magnified by the framing, though it does not cause breakdowns, is a small hole, sometimes only one broken thread, repeating regularly through the piece twenty-one to twenty-three inches apart and at a fixed

distance from the selvedge. This length of 21 to 23 inches is, as far as I know, the usual circumference of what I call the sand-rolls, or rough friction rolls which wind up the cloth on the loom. These holes are made by a rough place on the sand-roll of the loom as it winds up the cloth. "Sand rolls" made of tin with a cullender surface are particularly apt to make them.

The finish of the lawns deserves a word. For elasticity, body and general appearance it is essential that the starch put into the goods before framing thoroughly penetrate the threads, otherwise the finish is "weak-kneed," has no elasticity, nor handle. For the finisher, thorough bleaching of the cloth, cleaning out the threads to their very centre, is the foundation for a good finish. For the manufacturer, it is the careful preparation of the yarn, spinning it with twist sufficient to make a strong, substantial fabric, but not enough to make a harsh yarn which will resist the bleaching and starching; and second, sizing the warp yarns with a mixture which shall contain not only nothing harmful to the cotton fibre, but also nothing which will prevent a thorough bleach.

In weaving, the filling bobbins must not be mixed, any variation in the weight of the yarn or in the color of the cotton, showing in bands across the finished piece. Moreover the woven goods should be carefully handled to prevent rubbing the filling threads out of place, "fraying" the goods. This frayed appearance on delicate light-weight lawns cannot be entirely corrected by the scrimping action of the tenter-frame.

The color, the tint of white, is the last point, but a vital one from the selling point of view. A good white cannot be obtained from cheap, low-grade, dirty cotton. There are certain kinds of dark cotton which no amount of bleaching, no amount of blueing, will bring to a clear, attractive white. So when you are starting in to make goods for fine white lawns, start at the beginning and get, in the first place, good cotton, clean cotton.

WAXES IN WARP SIZING.

Mention has been made in the paper above of the importance in manufacturing of putting in the cloth nothing which will prevent a thorough bleach.

Since taking up this question of white lawn work, my attention has been particularly drawn to this matter of a thorough bleach in connection with our dyed work. We found on various grades of satines dyed in colors, that the warps were coming up lighter in shade than the filling yarns, causing the satines to have a threadbare, starved look. Investigation showed that on these grades, the filling was uniformly dyeing a deeper shade than the warp. An examination for waxes on some 40-inch, $\frac{96}{186}$, 4.00 yard satines in the gray, after steeping and after full bleaching, showed the goods to contain to the yard, the following amounts of waxy matters:

Gray,	0.4701 grams.
After steeping,	0.2915 "
After full bleaching,	0.2432 "

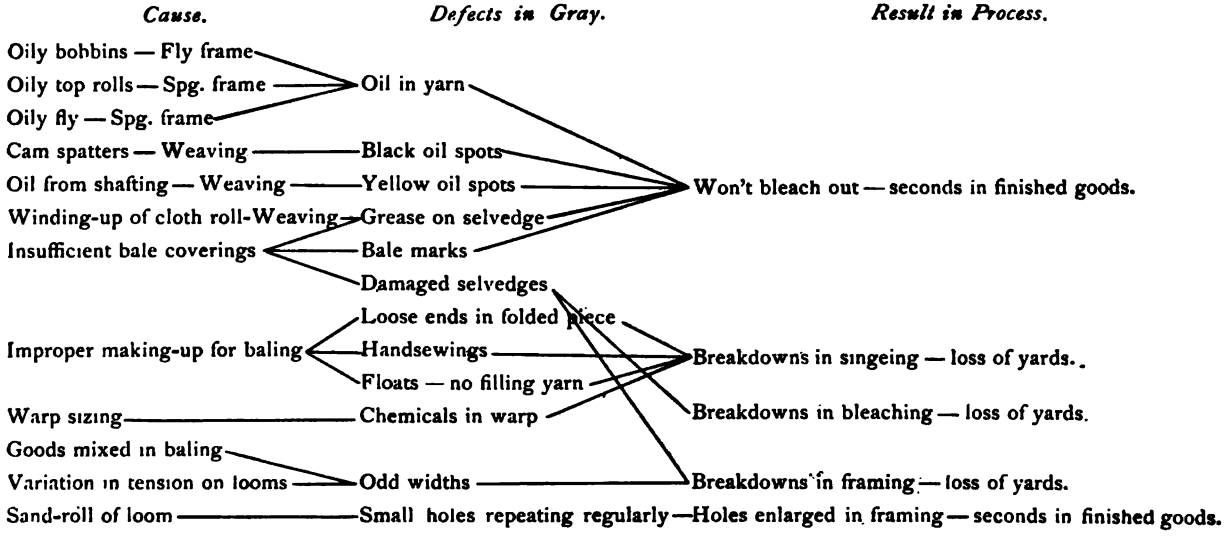
It is seen at a glance that the full bleaching process removes less than half of these waxes in the goods. From the above figures the amount of wax contained in a kier lot of some 24,000 yards would figure nearly 13 pounds in cloth which ordinarily after the bleaching process, would be found free from all foreign matters.

The following article from the "Dyer and Calico Printer" was found in last month's *Textile Record*, Philadelphia. It is very pertinent in this connection. It says in part:

"Of late, bleachers have experienced much trouble in getting pure goods. In fact, complaints in this direction appear to be very general; even the dyers of piece goods in some instances, are experiencing their share of the trouble, in being unable to get cotton piece goods dyed evenly.

A close study has developed one cause, which, while it may not be the only one, is in itself certain to produce a serious defect in any piece of cotton goods, viz., the use of paraffin and similar substances in connection with the sizing of warps.

SUMMARY OF PRINCIPAL DEFECTS IN GRAY GOODS WHEN RECEIVED AT BLEACHERY.


Cause.
Defects in Gray.
Result in Process.
Oily bobbins — Fly frame
Oily top rolls — Spg. frame
Oily fly — Spg. frame
Oil in yarn
Cam spatters — Weaving
Black oil spots
Oil from shafting — Weaving
Yellow oil spots
Winding-up of cloth roll-Weaving
Grease on selvedge
Insufficient bale coverings
Bale marks
Won't bleach out — seconds in finished goods.
Damaged selvedges
Loose ends in folded piece
Improper making-up for baling
Handsewings
Floats — no filling yarn
Breakdowns in singeing — loss of yards.
Warp sizing
Chemicals in warp
Breakdowns in bleaching — loss of yards.
Goods mixed in baling
Variation in tension on looms
Odd widths
Breakdowns in framing — loss of yards.
Sand-roll of loom
Small holes repeating regularly
Holes enlarged in framing — seconds in finished goods.

Years ago paraffin was brought to the notice of manufacturers and was adopted by many mills, as its use improved the weaving qualities of warps. Almost immediately a huge wave of misfortune began to roll in. First came mildewed gray goods for the simple reason that where paraffin is used in warp size, it simply remains therein in the form of an emulsion, so that when the warp is saturated with the sizing material the moisture penetrates the same, but the paraffin remains on the outside. In drying, the moisture cannot get out, although the warp appears dry, as paraffin hardens at quite a high temperature, but in a short time the absorbed moisture generates mildew.

Next came the bleacher's inability to get pure goods as paraffin is a peculiar article and will not dissolve in any of the chemicals that are used in the process of bleaching.

* * *

The dyer found his pieces uneven from the same cause. In boiling off, he simply spread the paraffin on to the filling, and wherever it remained had spots of a lighter shade after the dyeing process, as his dye liquor could not penetrate through a material which resisted it.

These results caused paraffin to be discarded in a very decided manner, and it is to be regretted that it has appeared again, although its use is at the present time restricted to some of the newer mills, the older ones not having forgotten past experiences in this direction."

We are looking further into this matter of wax and paraffin in the warps and I hope by next fall to present to this Association the results we get in more detail. Owing, however, to the great importance and to the serious nature of this question of waxes in the warps, I take this opportunity today to bring it thus early to your attention.

Mr. DANIEL MOORE BATES. I should be glad if any of you gentlemen here could give me information as to the revival of the use of paraffin, so far as your knowledge goes, as we have come across this trouble only within the last two or three months, and we do not really know that we are in trouble until we get in the midst of it.

The PRESIDENT. We will now proceed to the last paper of the afternoon, Report of the Committee on Fire Tests of Cotton Bales, EDWARD W. THOMAS and WILLIAM D. HARTSHORNE.

Mr. WILLIAM D. HARTSHORNE. The preliminary report which is presented in type here today was presented at the New York meeting and will therefore not be read again today, as many of you no doubt heard it then. I will simply add that the conclusions which the committee in full have arrived at were not then before the speaker, although apparently they have not varied materially from what he then presented to you. The whole paper, indeed, is a matter of considerable detail which it will be impracticable to read at this time. The pictures you will all be able to appreciate, however, as they the mselves tellthe story very largely. The question of the final conclusions, however, is one upon which there may be, perhaps, a difference of opinion, but I will give them here as presented by the committee as a whole, and, so far as I know, they were unanimous in their general effect. First, as to the flash test, on page 316 of this report, near the close, beginning: "One result stands out," and ending, "There seems to be but little gain by using the special covering treated with the fire retardant."

I might say, in explanation of that, that in order to test the question of what the possible benefit might be of some of the chemical fire retardants that are on the market, an extra covering saturated as described was provided for each kind of round bale—on a separate one, however, from the regular test—and the same flash test applied. Those of you who were not present at the New York meeting might perhaps be advised that this

flash test was made by the use of an ordinary gasoline torch, and for such periods of time as the log will show you if you take time to read from: "Baled dry goods that are not completely covered," on page 316 and continuing as far as the end of page 318.

I do not think, Mr. President, that it is necessary for me to present any more of this report; It is all before the meeting.

The PRESIDENT. If there are any of the underwriters' engineers present it might be interesting to hear from them on this question.

*REPORT OF SUB-COMMITTEE ON FIRE TESTS OF COTTON BALES.

To the President and Members of the
New England Cotton Manufacturers' Association.

The undersigned were appointed by the Board of Government as a sub-committee to represent the New England Cotton Manufacturers Association on a committee of the National Fire Protection Association to make experiments upon the relative fire hazard of cotton. As the details and results are contained in the report of the whole committee, it was thought best that the members of the sub-committee should present a verbal report referring to the complete report which is annexed hereto for various details. The verbal reports were presented as follows at the New York meeting, but the publication in the Transactions was postponed, because the report of the full committee was not complete at the time.

Mr. WILLIAM D. HARTSHORNE. I would like to state, Mr. President, that your representatives are laboring under some embarrassment in presenting anything to you this afternoon, from the fact that the final authorized report of this committee is not yet ready for publication. We have received letters from the chairman of the committee requesting that such information as we may feel justified in giving out here today shall be considered as confidential and not to be given to the press, and that no official publication shall be made until the report has been formally promulgated by the National Association of Fire

* For further reference on this subject see previous Report of Committee, Vol. 73, p. 374.

Underwriters. I have here the log of the reports as prepared by the persons who were present at the tests, and I have also a series of pictures representing the different stages of the fire tests.

I will say that so far as I was able to observe, these tests were conducted with absolute impartiality. There were represented there those who were interested in the two patented bales, the American Cotton Co. round lap bale and the Lowry round bale, and there were also tests made in connection with these of the ordinary uncompressed bale, or the gin compressed bale as it is called, and the recompressed bale.

The committee had decided that in order to make a comparative test two methods should be used:

First, that each kind of bale should be burned in a separate hut, and then that all four classes should be burned in the same hut. These four huts were built as nearly identically alike as practicable, and practically about the same quantity of fuel — about half a cord — placed under each. In the larger hut, which was to contain representations of each of the four kinds of bales there was also placed a bale of common sheeting, and under the hut was a larger quantity of fuel, producing naturally a much hotter fire. In addition to the fire tests, there were also immersion tests provided for. Each of the four kinds of bales was placed in a large vat and held down under water so that its floating capacity would not prevent it from absorbing its full quota of water. The returns on this are given, and the salvage which was obtained from the fire tests is also here logged. The full details of everything that occurred are presented on the log, but will not, of course, be presented in form at present.

The burrowing tests, which were to occupy a considerable length of time, could only be made at a laboratory. They were left to be made at the Chicago laboratory, and the reports from them are not yet at hand. The flash tests, however, were conducted on the grounds at Chester at the same time that the other tests were made, and are in some respects, I think, the most important of all.

In regard to the actual figures which were obtained for the salvage of the cotton, I have gone through this report and made up rather hurriedly a statement which may convey to you some idea of the results. In the first place I will take up the immersion tests. I have arranged them in the form of a table, giving first the density in pounds per cubic foot of each of the four kinds of bales tried. In making a calculation of this density, I have been obliged to estimate rather than to calculate some of the figures, because I could not tell exactly what the shape was of the uncompressed and recompressed bales, but I think my figures are approximately correct. Of course, in the case of the round bales, they are not probably out of the way, because the bales are practically cylinders. The Lowry bale, then, by these figures is 40 pounds per cubic foot, including of course, the wrappings and all; the American round lap bale 32 pounds per cubic foot; the recompressed bale from 23 to 24 pounds. I could not be sure how near that might be. The gin compressed bales are about 13 pounds per cubic foot. The latter, therefore, is a very much more bulky affair than any of the others.

Now as to the amount of water absorbed, the Lowry bale absorbed by weight 20 per cent.; the American round lap bale 35½ per cent.; the recompressed bale 162 per cent.; the gin compressed bale 207 per cent.

In the salvage test to show how much dry cotton there was left in these bales, the Lowry showed 75.7 per cent.; the American round bale 69.6 per cent., and neither of the others any. To be sure, the recompressed bale was not so fully saturated as the gin compressed bale, but nevertheless all the cotton contained in it was more or less wet.

To take up now the resume of salvage results for the burned bales, the gin compressed bale, which was burned in hut No. 1 — I think perhaps, Mr. President, these photographs might be distributed before I actually take up that discussion, and it perhaps would be better to arrange them. You will readily recognize, gentlemen, the order in which these pictures were taken. The No. 1 hut, which is the first series presented, con-

tained the gin compressed bale, or the uncompressed bale as it is sometimes called. You will see by the photographs the character of the structure which was used and the pile of wood under it, and the successive stages of the condition of the fire, and the final burned up state. While these are being examined, I will proceed with the statement as to the salvage conditions.

The gin compressed bale, hut No. 1, returned a salvage in clean dry cotton of 50.37 per cent.; a surprisingly large amount when you consider what a loose bale it was, and what a really severe fire it was in. The American round lap bale in hut No. 2 returned 68.06 per cent. I might say here that a separate salvage was made of the two bales which were at the beginning on the top of the pile, as shown in the photograph, and which during the very last stages of the fire slipped off and out of the fire, but very close to it, so that we did not suppose that this fact would make a very great difference in amount of effect as compared with the others. Nevertheless, it was thought best that a separate salvage should be taken. And I hardly think now, that the difference which I will give you in a moment was due to the fact that they slipped out of the fire, but perhaps to the fact that the bottom bales were rather more freely exposed during the test. The salvage, as I say, then, on the three bales which remained in the fire was 66.8 per cent., and the salvage in the two which slipped out was 70 per cent. The Lowry bale gave a salvage return of clean dry cotton of 33.14 per cent. The recompressed bale, the ordinary square compressed bale of commerce, 59.22 per cent — a very excellent showing.

A further column may be given of the salvage from burned pickings, which has some bearing upon the value of the salvage returns. The percentage of the burned pickings recovered from the gin compressed bale was 16.29; of the American round bale 14.67; of the Lowry bale 42.06; of the recompressed bale 15.24. As given by the salvage people, the salvage value which was based on the assumption that the partly burned cotton was worth three and three-fourths cents a pound, without regard to its original value — and I might say that the cotton was of different

values, but the same value was put upon the burned cotton in them all. The valued results, therefore, showed perhaps rather more in proportion in favor of those bales which had the larger amount of burned cotton, because they contained the lowest priced cotton. The gin compressed bale, showed a salvage value of a little over 50 per cent.— 50.45; American, 70.89; Lowry, 48.35; recompressed, 62.4. Then comes a question of how much of this cotton was actually burned up. The gin compressed bale showed an actual loss of 33⅓ per cent.; American round bale, 17.27; Lowry, 24.8, and the recompressed bale, 25.54. You will notice very particularly that on the Lowry bale the amount of cotton which was actually destroyed (greater as it was than the American round bale) was not so great as the recompressed bale, although, owing to the peculiar character of the build of this bale, as you will see by the photographs, as soon as the bands broke, the cotton shot right out and was so exposed to the fire that it really had greater opportunity of burning after that stage than did even the gin compressed bale.

When all these bales was put into hut No. 5, the returns were not very different — were very similar in fact. The recompressed bale showed 64.65 per cent.; the gin compressed 40.35 per cent. (a loss over the former — a rather hotter fire it was supposed); the American round bale was almost exactly the same — 70 per cent.; the Lowry 35.41 per cent.— a trifle of a gain over the individual hut, but showing very plainly that the comparative results on the four huts were a reasonable comparison.

The cotton sheeting bale, which was put in at the same time, of course, did not show any salvage for value — it would not under the circumstances — but in the burned pickings, there was about 64 per cent. of the whole original weight. The object of putting in this cotton sheeting bale was to show the fact that while according to the fire underwriters the rate of insurance, as I understand it, on cotton sheeting is lower than on cotton, yet it is certainly true that in a fire such as these bales were in, while the value to be recovered from the cotton sheeting would

be absolutely nothing, we have a very large percentage of valuable recovery from any of the bales of cotton.

I think I need not comment on the rest of the table now, but will proceed to mention what seems to me the most important conclusion to be derived from these tests, and which relates to the flash test, as it is called. Each of the four classes of bales was exposed for a limited period to an ordinary gasoline torch. The log will show exactly how long, and exactly what result was accomplished, but it was perfectly plain from all of them that whenever the cotton was exposed on the outside of these bales it caused an immediate flash over the whole bale, and would doubtless in a storehouse or in the warehouse where it was — any place where cotton was piled — cause an extremely rapid spread of fire from one end to the other; and you all know in what an exposed condition most cotton bales are, whether they be the recompressed bale or the ordinary common bale. On the other hand, the Lowry bale, which had only a little cotton exposed, would flash only on the end, and that is something that they can certainly remedy and make their bale equally as efficient in that respect as the American bale.

On the American bale, which was completely covered with a fine quality of burlap, there was absolutely no spread of fire under 35 seconds exposure to a hot torch flame. This, of course, was due to the fact that this was a fine quality of burlap, and tightly stretched around the material. Whatever fire was produced was easily extinguished by just the flap of a newspaper. There does not seem to be any reason to my mind why this kind of a cover should not be applied to every kind of a cotton bale, whether it be the compressed bale or the uncompressed bale, and save this element of flash hazard which seems far more important than any result which might be obtained as a salvage estimate, because it is only a question of how much of a fire you have, whether or not you would burn up any bale that was ever produced.

I think that, gentlemen, is all that we would be at liberty to give you today, and I trust that the request of the chairman of

the committee, Mr. HEXAMER, will be observed, and no publication made of these results until the final report and all the conclusions of the committee have been formulated and presented to the public. [Applause.] I might say that Mr. THOMAS has some further information upon other tests and can give them if they are of interest to the meeting.

Mr. THOMAS H. SMITH. Will Mr. HARTSHORNE tell us how to put out the fire in a cotton bale the best way? I thought you had immersed them — tried that.

Mr. WM. D. HARTSHORNE. The immersion tests which we were to try were not to put out the fire, but to discover how much damage would be done by water to the different kinds of bales. In that test the Lowry bale undoubtedly stood the best of all. It absorbed only 20 per cent. in 48 hours.

Mr. THOMAS H. SMITH. That was without being burned?

Mr. WM. D. HARTSHORNE. No burning whatever. I meant to say that that immersion test lasted 48 hours. All the bales were completely submerged for 48 hours.

Mr. THOMAS H. SMITH. I thought you put them in the water to put the fire out.

Mr. WM. D. HARTSHORNE. No, that was done by a fire department hose.

Mr. ARNOLD B. SANFORD. That was the only instance in which the Lowry bale compared favorably then?

Mr. WM. D. HARTSHORNE. Well, except in the covering. For the flash tests the covering was certainly good and if the ends were covered it would be certainly equally good with the others on these flash tests.

Mr. E. W. THOMAS. Mr. President and gentlemen:

A test somewhat similar to these was made by the Associated

Companies in Lowell in June, 1899, but the comparison at that time was simply between the Lowry bale and the American bale, and the final results of that test showed in the American bale, of good cotton saved 52.32 per cent., and of the Lowry bale 15.99 per cent. The cotton actually disappearing in the fire was 29½ per cent. of the American bale, and 42.8 per cent. of the Planter's or Lowry bale.

In May, 1901, was perhaps the best example in which the compressed bale and Lowry bale in the same storehouse in New Hampshire were exposed to quite a serious fire. There were 853 bales of compressed cotton and 400 Lowry bales in the same compartment on fire at the same time, and the salvage test of that case gave, of the compressed bale 46½ per cent.; of the Lowry bale 16.87 per cent., and of cotton that actually disappeared, 24 per cent. in the case of the compressed bale, and 44¾ per cent. of the Lowry bale. These figures follow very closely both in the test and in the actual fire in this New Hampshire storehouse with the results obtained by the Factory Association in a recent test at Newark. I do not know whether there is anything further to say than that those are concrete figures, and let you judge accordingly.

Mr. ARNOLD B. SANFORD. I would like to ask Mr. THOMAS a question, that is, in regard to a fire in a cotton storehouse. If you had cotton stored — for instance, 400 bales of one kind and 300 of another — wouldn't there be something to show in favor of one or the other in regard to the way that fire took place? I am now talking about the storehouse — the fire being put out at a certain stage. Cotton might be stored in one corner of it of one kind and other cotton in another corner; wouldn't it figure against one in that case?

Mr. E. W. THOMAS. Oh, I think it very likely.

Mr. ARNOLD B. SANFORD. It is pretty difficult to get at this thing, you know, unless you make a total destruction.

Mr. E. W. THOMAS. The only conclusion you can arrive at, it seems to me, is that the old fashioned square bale, if properly covered, is the better bale to have today, so far as fire is concerned.

Mr. ARNOLD B. SANFORD. You are familiar with the idea that I have. If your storehouse takes fire you would immediately call in the fire department and it is extinguished as early as possible. Now if you had various lots of cotton it would not be fair to estimate the salvage of one against the other. One kind at one end of the storehouse might be subjected to a tremendous blaze, and another kind might be at another part of the storehouse where there might be scarcely any, so that I do not see how you can make a fair comparison.

Mr. E. W. THOMAS. No, but in the lack of any data we have got to take whatever actually occurs.

Mr. ARNOLD B. SANFORD. I am speaking now of the New Hampshire fire. Of course, at these tests which you are giving the cotton was totally destroyed, and that affords a fair comparison. The New Hampshire fire would not be a fair comparison.

Mr. E. W. THOMAS. In the case of the Lowell test it was quite similar. Huts were built and cotton of each kind was put in the shed and set on fire the same way, and each allowed to burn a certain length of time, and then the fire department put the fire out.

Mr. ARNOLD B. SANFORD. And your conclusion is, you think the square bale stands pretty well with the rest of them?

Mr. E. W. THOMAS. If properly covered.

Mr. WM. D. HARTSHORNE. Mr. President, there is one point which I will call attention to. I think that perhaps a little misapprehension may have arisen from the fact that this report from which Mr. THOMAS has just read speaks of the test

at "Newark." I think it may be that the tests at Lowell are referred to as comparing fairly well.

I would like also to say that my attention has been called to the fact that the matter of covering the ordinary compressed bale with a fine quality of burlap has been tried and has not been found successful, because it was not strong enough. I cannot myself see why it could not be made strong enough to accomplish the purpose. Undoubtedly, the perfect shape of the American bale, being perfectly round, or rather perfectly cylindrical and flat ended, enables the burlap to be very tight upon the material itself, and in that way would be favorable to the prevention of a fire extending rapidly from one bale to another. If it were loose, as it must necessarily be partly on the rough ordinary square compressed bale, even with a fine quality of burlap there would be somewhat more exposure; but in any case it seems to me that if all cotton were completely covered up there could be no such flash from one end of the building to the other as we often hear of when a slight fire is started in a warehouse.

RESUME OF RESULTS OF IMMERSION TESTS.

Kind of Bales.	Density Dry.	Per cent. Water Absorbed.	Salvage Test Dry Cotton.	Salvage Value.	Remarks.
Lowry,	40 lbs.	20%	75.7%	87.2%	
Amer. Round,	34 "	35½%	69.6%	80.2%	
Recompressed,	23-24 "	162 %	none		
Gin compressed,	13 "	207 %	none		

RESUME OF SALVAGE RESULTS FROM BURNT BALES.

Kind of Bales.		Salvage Sound Dry Cotton.	Salvage Burnt Pickings.	Salvage Value.	Per cent. Consumed.
Gin comp.	Hut 1	50.37%	16.29%	50.45%	33-⅓%
Am. Round	" 2	68.06%	14.67%	70.89%	17.27%
Lowry	" 3	33.14%	42.06%	48.35%	24.80%
Recomp.	" 4	59.22%	15.24%	62.4 %	25.54%
In Hut No. 5.					
Recomp.		64.65%	13.86%	68.15%	21.49%
Gin comp.		40.35%	18.42%	44.78%	41.23%
Am. Round		70 %	13.11%	72.22%	16.94%
Lowry		35.41%	41.63%	50.21%	22.96%
Cot. Sheeting			64.1%		35.9 %

APPENDIX.

REPORT OF COMMITTEE ON THE RELATIVE FIRE HAZARD OF COTTON AS BALED BY VARIOUS METHODS.

Chairman, CHARLES A. HEXAMER.

F. M. GRISWOLD, H. C. HENLEY,
H. A. FISKE, W. H. MERRILL, JR.

and

Representing the New England Cotton Manufacturers' Association,

WM. D. HARTSHORNE, E. W. THOMAS.

Secretary, EVERETT U. CROSBY.

Your Committee to whom was intrusted the testing of cotton as variously baled, have the following report to offer:

OBJECTS.

It was determined to investigate only those features of moment to the underwriters — namely, the relative merits or demerits of the various bales in the following particulars:

Extent subject and contributing to flash fires.

How affected by being subjected to a continuous fire for a given period.

How affected by immersion in water for a stated time without having previously been subjected to fire.

To what extent susceptible to fire burrowing within the bale.

A schedule of these various points to be tested and determined was prepared, submitted to the Committee Members, The American Cotton Company and the Planters Compress Company, and unanimously adopted.

Inasmuch as no particular person or company represented the gin bale or the recompressed bale, concurrence of those interests could not be obtained. It was also developed that those identified with new methods of packaging cotton in small square bales were not prepared to submit samples for these tests.

FLASH TEST. RECOMPRESSED BALE.

After application of flame for five seconds and then allowed to burn for twenty-five seconds.

TYPES OF BALES TESTED.

The four types of bales tested are here briefly described for general information.

THE "GIN BALE."

Frequently spoken of as the "Plantation Bale" also as the "Uncompressed Bale."

It is the product of the first compression at the gin and is usually forwarded to a cotton compress for recompression, or purchased for use at no great distance from the gin. It varies greatly in size and contour, and a statement has been made that the dimensions will average about 30 x 40 x 58 inches, weighing approximately 12 pounds per cubic foot. Covered by open mesh jute bagging and bound with steel or iron bands secured by iron buckles.

THE "RECOMPRESSED BALE."

Also known as the "Compress Bale."

This is the bale after having been reduced in size and increased in density at the compress above referred to, thus being prepared for shipment to Northern mills or abroad. It is usually about 18 x 40 x 58 inches and weighs about 22 pounds per cubic foot. Covered with open mesh jute bagging and bound by steel or iron bands secured by metal buckles.

THE "LOWRY BALE."

The Planters Compress Company, proprietors. Cylindrical in form, approximate dimensions 36 inches long, 18 inches diameter, weight about 250 pounds per bale or 47 pounds per cubic foot.

This bale is made by feeding cotton through slots at top of the press to the upper end surface of the bale, which is made to revolve while under pressure, bale being set on end. In the past bale has been held by four wires passing through core and around outside, but the proprietors now propose to use strap steel and buckle extending in two bands at right angles around exterior of bale lengthwise and this is the type of binding submitted for our test. After binding, a closely woven burlap bag is slipped on over bale which is tied by a draw string, thus leaving on opening of a few inches at one end where cotton is exposed to view. There is now no opening extending lengthwise through bale but the cotton at core is less compressed than elsewhere in the bale.

FLASH TEST. GIN BALE.

After application of flame for five seconds and then allowed to burn for twenty-five seconds.

THE "AMERICAN BALE."

Commonly called the "Roundlap Bale."

The American Cotton Company, proprietors. Cylindrical in form, 35 inches long, 22 inches in diameter, weight of bale about 270 pounds, i. e., 35 pounds per cubic foot. The preceeding are average dimensions and weight. Bales from Texas are apt to be slightly larger.

This bale is made by compressing a sheet of cotton between rollers and winding up the lap into a bale which is practically self contained due to adhesion of the fibre, therefore, no ties are used. With the last revolution of the press a closely woven burlap covering is tightly wrapped about the bale until it overlaps several inches when it is sewn together and to burlap ends thus leaving no exposed cotton.

TESTS AT CHESTER, PA.

The Flash, Fire and Immersion tests were held at Chester. Pa., August 4th to 7th. inclusive, 1902.

The Committee Chairman had purchased four gin bales and four recompressed bales from a cotton firm in Atlanta, Ga. Twelve American bales and twelve Lowry bales were obtained from their respective manufacturers, the former being shipped by freight from Waco, Texas, the latter from Memphis, Tenn. All the cotton reached Chester in good condition and was so judged after being viewed by the Committee and representatives of the round bale companies. The bagging coverings of the gin and recompressed bales left much cotton exposed, yet, in this respect, were judged average bales. The American and Lowry bale coverings were slightly torn by weighing on the beam scales.

Arrangements were made with the well-known cotton and waste dealers, J. Wallworth & Sons, of Chester and Philadelphia, to salvage the cotton, and their labors were performed most satisfactorily.

The Flash and Fire tests occurred on the afternoon of August 5th, the following Committee members being present:

Chairman HEXAMER, Messrs. GRISWOLD, FISKE, HENLEY, W. C. ROBINSON (representing Mr. MERRILL), Mr. HARTSHORNE and Secretary CROSBY.

Also representatives of the American Cotton Company and the Planters Compress Company attended, as well as a number of fire and marine underwriters, including Mr. F. D. P. BALCH, the latter assisting in recording the log of Fire Test.

Mr. F. TAYLOR, Engineer of the Underwriters' Laboratories, had been intrusted with the preparations for all the tests under guidance of the Chairman.

FLASH TEST. "DRY GOODS" (PRINT CLOTH).

After application of flame for five seconds and then allowed to burn for twenty-five seconds.

LIST OF BALES TESTED.

The following gives the type, test number, original weight and test location of each of the bales.

NOTE — Tag No. 1 was mislaid and was replaced by tag No. 34.

Weights given in pounds.

AMERICAN BALES.

Bale No.	Test.	Weight.	Remarks.
34	Large hut No. 5	267	Fire retardant, extra covering.
2	Large hut No. 5	282	Original covering.
3	Immersion test	270	Original covering.
4	Small hut No. 2	276	Original covering.
5	Small hut No. 2	276	Original covering.
6	Small hut No. 2	280	Original covering.
7	Small hut No. 2	284	Original covering.
8	Small hut No. 2	290	Original covering.
9	Burrowing test	263	Original covering.
10	Burrowing test	264	Original covering.
11	Not used	260	Original covering.
12	Not used	258	Original covering.

LOWRY BALES.

13	Large hut No. 5	257	Fire retardant, extra covering.
14	Burrowing test	258	Original covering.
15	Immersion test	260	Original covering.
16	Small hut No. 3	258	Original covering.
17	Small hut No. 3	247	Original covering.
18	Small hut No. 3	241	Original covering.
19	Not used	236	Original covering.
20	Small hut No. 3	264	Original covering.
21	Not used	256	Original covering.
22	Large hut No. 5	257	Original covering.
23	Burrowing test	258	Original covering.
24	Small hut No. 3	236	Original covering.

RECOMPRESSED BALES.

25	Large hut No. 5	577	Original covering.
26	Small hut No. 4	545	Original covering.
27	Small hut No. 4	551	Original covering.
28	Immersion test	560	Original covering.

GIN BALES.

29	Small hut No. 1	540	Original covering.
30	Large hut No. 5	542	Original covering.
31	Small hut No. 1	393	Original covering.
32	Immersion test	507	Original covering.

DRY GOODS.

33	Large hut No. 3	290	Original covering.

Bales Nos. 3, 15, 28 and 32 were weighed on a beam scale at the mill of Shaw & Ezrey, where the immersion tests were held. All the other bales were weighed on a beam scale furnished by H. B. Birtwell, of Chester. The weighing was done in the field immediately before the bales were placed in position in the huts.

FLASH TEST. AMERICAN BALE.

After application of flame for five seconds and then allowed to burn for twenty-five seconds. The dark spot on the bale shows where the flame was applied. The point of application was nearer ground during test, the bale having been rolled before photograph was taken.

FLASH TEST. AMERICAN BALE.

After application of flame for thirty-five seconds.

ASSEMBLAGE OF BALES FOR FIRE TEST.

Small Hut No. 1.

GIN BALES.

Bale No.	Weight.	Bale No.	Weight.
31	393	29	540
Total	933		

Small Hut No. 2.

AMERICAN BALES.

Bale No.	Weight.
4	276
5	276
6	280
7	284
8	290
Total	1,406

Small Hut No. 3.

LOWRY BALES.

Bale No.	Weight.
16	258
17	247
18	241
20	264
24	236
Total	1,246

Small Hut No 4.

RECOMPRESSED BALES.

Bale No.	Weight.	Bale No.	Weight.
26	545	27	551
Total	1,096		

Large Hut No. 5.

Bale No.	Weight.		Remarks.
34	267	American bale.	Fire retardant, extra covering.
2	282	American bale.	Original covering.
13	257	Lowry bale.	Fire retardant, extra covering.
22	257	Lowry bale.	Original covering.
25	577	Recompressed bale.	Original covering.
30	342	Gin bales.	Original covering.
Total cotton	1,982		
33	290	Bale of dry goods.	Original covering.

FLASH TEST. LOWRY BALE.

After application of flame for five seconds and then allowed to burn for twenty-five seconds.

FLASH TEST. LOWRY BALE.

After application of flame for thirty-five seconds.

FLASH TEST.

To compare the rapidity with which a fire would spread on the surface of each type of bale and the difficulties of extinguishing such a fire in its early stages.

This series of tests was made in the open air, but a slight wind prevailed. A common gasoline hand soldering torch was used with an average flame, and the torch held so that the hottest part of flame was against surface of bale, the end of burner being from six to eight inches distant.

Test No. 1.

Gin bale standing on end. Torch applied to centre of one side. This bale was practically devoid of bagging covering, the cotton being exposed but fairly well matted down.

The flame was applied for 5 seconds and the cotton allowed to burn for 25 seconds more. When flame was applied, it almost immediately spread over the entire side of bale, and in a few seconds the bagging at sides began to char. By the end of the 30 seconds the whole side was burning, although it was a surface action only, and was easily extinguished by water and a broom. It was not the intention to permit these fires to burn long enough to have any "burrowing" effect prior to extinguishment.

Test No. 2.

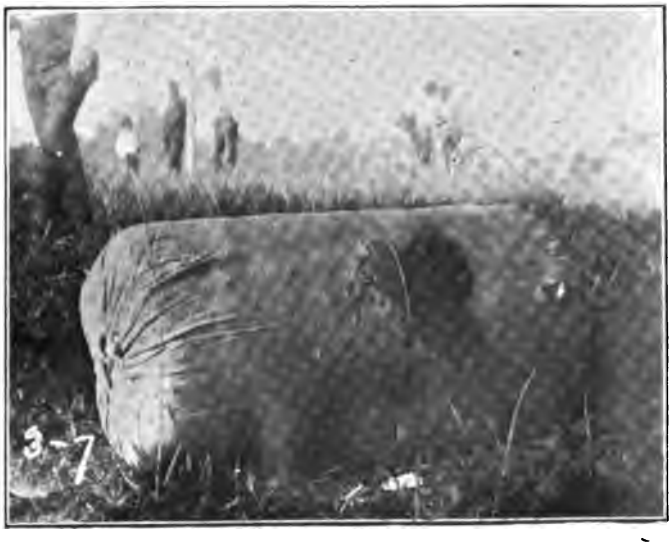
Ordinary recompressed bale standing on end. Torch applied to centre of narrow side. This side was partially uncovered, and the exposed cotton was loose and fluffy, being considerably more so than with the gin bale.

Torch was applied to the uncovered portion, and fire almost immediately spread over the exposed cotton. The torch was removed after 5 seconds, and the cotton allowed to burn for 25 seconds. The jute bagging began to burn very shortly after the torch was applied and both the exposed cotton and the bagging were well on fire at the end of 30 seconds, when fire was extinguished by water and a broom.

There was considerably more fire attending this test than No. 1, owing to the cotton surface being looser, and also because the bagging covering was coarser and burned more freely.

Several minutes after fire had been apparently extinguished it broke out again, showing that probably it had worked in some under the surface.

FLASH TEST. LOWRY BALE.
After application of flame on cotton at exposed end for five seconds and then allowed to burn for twenty-five seconds.



FLASH TEST. LOWRY BALE.
With extra fire-retardant covering, after application of flame for five seconds.

Test No. 3.

American bale lying on side. This bale was well burlapped and thoroughly covered, except for a few small openings due to rough handling when weighing with the beam scales.

Torch was applied at side and a little underneath, where burlap was whole. Torch withdrawn after 5 seconds, and then 25 seconds permitted to elapse before extinguishment, as in previous tests. Burlap was charred over a small area, being practically that covered by flame from torch, and the cotton underneath was somewhat scorched.

When torch was removed the burlap continued to smoulder and there were a few sparks. There was no flame and fire did not spread. There were no sparks in the cotton underneath. Fire was easily extinguished by striking with a folded newspaper.

Test No. 4.

Bale of cotton print cloth in the grey. Laid on side and torch applied at centre of uncovered end for 5 seconds, and then 25 seconds elapsed as in previous tests when fire was extinguished.

About four to six inches square scorched, and continued burning after torch was withdrawn. Spread slightly and slowly. Very little flame. No difficulty in extinguishing by striking with a folded newspaper.

Test No. 5.

American bale with outer covering of burlap which had been treated with the fire retardant solution.

Bale lying on side and torch applied as in test No 3. Torch not removed until 35 seconds elapsed. Burlap charred over an area of six inch circle. Cotton underneath was somewhat charred and smoked slightly. No flame. Fire did not spread, and was easily extinguished.

Test No. 6.

Lowry bale with an additional burlap covering treated with a fire retardant solution as for test No. 5.

Torch applied for 35 seconds. Burlap charred as in test No 5, but no flame. The burlap appeared to burn a little more freely than in test No. 5. The bale was somewhat more loosely covered. Bale laid on its side and torch was applied at the centre of side.

Cotton underneath the burlap was somewhat scorched, but no fire. The underneath covering of untreated burlap showed sparks, and the

LOCATION OF BALES

HUT Nº 1.
SECTION.

GIN BALES

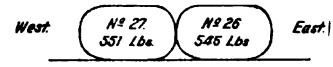
HUT Nº 2.
SECTION.

AMERICAN BALES

HUT Nº 3
SECTION

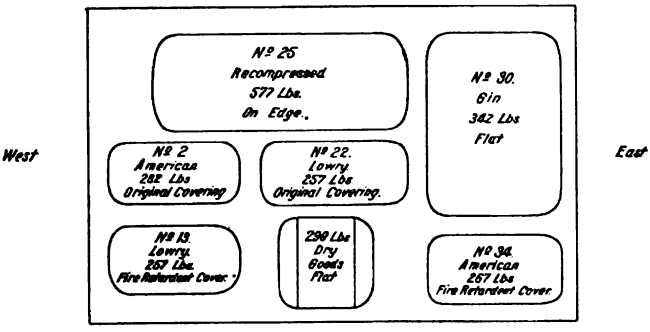
LOWRY BALES

HUT Nº 4
SECTION



RECOMPRESSED BALES

HUT Nº 5 - *PLAN*



fire appeared to creep some at this point, but was extinguished without trouble as in tests No. 4 and No. 5.

Test No. 7.

Lowry bale with ordinary covering. This bale was well burlapped, except that the cotton was exposed over a large portion of that end of the bale where the draw-string was located. Bale laid on its side.

7, A. — Torch was first applied to the centre of the side, and was removed after 5 seconds had elapsed. Fire was allowed to burn for 25 seconds. The burlap ignited and fire spread slowly, but there was practically no flame.

The burlap appeared to burn a little more freely than in test No. 5. Cotton underneath was scorched, but there was no sign of fire.

7, B. — A second test was made on the end of the bale where the cotton was exposed. Torch was applied for 5 seconds, and cotton allowed to burn for 25 seconds more. Fire spread immediately over the exposed cotton and burned quite freely, igniting the burlap. Fire was easily extinguished.

7, C. — A third test was made on this bale. Torch was applied for 35 seconds as with the treated bales. The burlap became well ignited, but fire spread very slowly. The cotton inside was merely scorched. This showing was but little worse than with the 5 seconds test mentioned above. Fire was easily extinguished by striking with a folded newspaper.

Test No. 8.

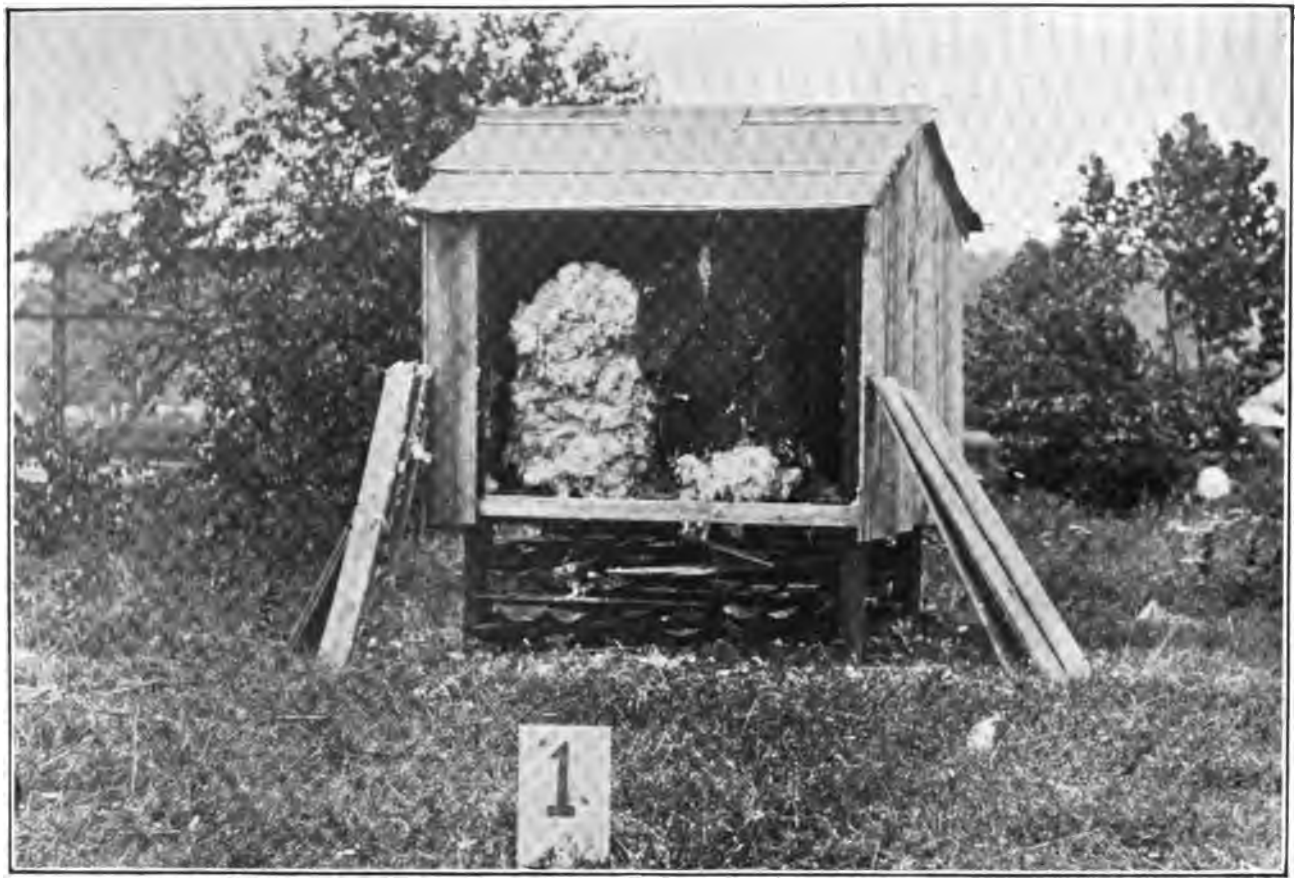
American bale with ordinary covering. Torch was applied for 35 seconds as with the treated bales.

Bale laid on its side and torch applied at center of side. Burlap was somewhat burned and fire spread very slowly. Cotton slightly scorched underneath. But little flame, and the wind blew the flame out soon after torch was removed.

The various bales used in the flash tests were subsequently placed in Hut No. 5, and it was noted that the gin bale and recompressed bale were afire some time after being placed in the hut, and before the fire under hut was started.

FIRE TEST.

To determine the relative salvage obtainable after being subjected to a continuous fire of one hour duration.



HUT No. 1, CONTAINING TWO GIN BALES, BEFORE FRONT WAS REPLACED AND FIRE STARTED.

Four separate wooden huts (one for each type of bale, numbered 1 to 4 inclusive) were constructed of the same material, size, and with the same amount of fuel beneath each.

A fifth and larger hut was erected (numbered 5) in which to burn in a common fire one of each type of bale, one bale of dry goods (print cloth) and an additional Lowry and American bale, each of the two latter having an extra burlap covering treated with a fire-retarding solution.

Huts Nos. 1 to 4 inclusive, were 6x7 feet x5 feet high. Frame 4x6 inch pine. Sides and roof of 1-inch yellow pine. The huts rested on 4x6-inch pine girders, in turn supported by wooden posts set in the ground. Wooden floor timbers spiked into the girders and set about 12 inches apart, formed a grid on which the bales rested, the spaces between not being floored over. Average distance from bottom of floor timbers to ground, 25 inches. The space between timbers and ground was practically filled with dry slab wood, laid so as to allow air space for quick combustion. At bottom of slab pile wood shavings and a little pine kindling sprinkled with small amount of kerosene was used. Less than one half cord of slabs was placed under each of these huts. The amounts and arrangement of the fuel were fairly uniform.

Tar paper has been placed on roofs to keep out moisture. This was removed immediately preceding the firing of each hut.

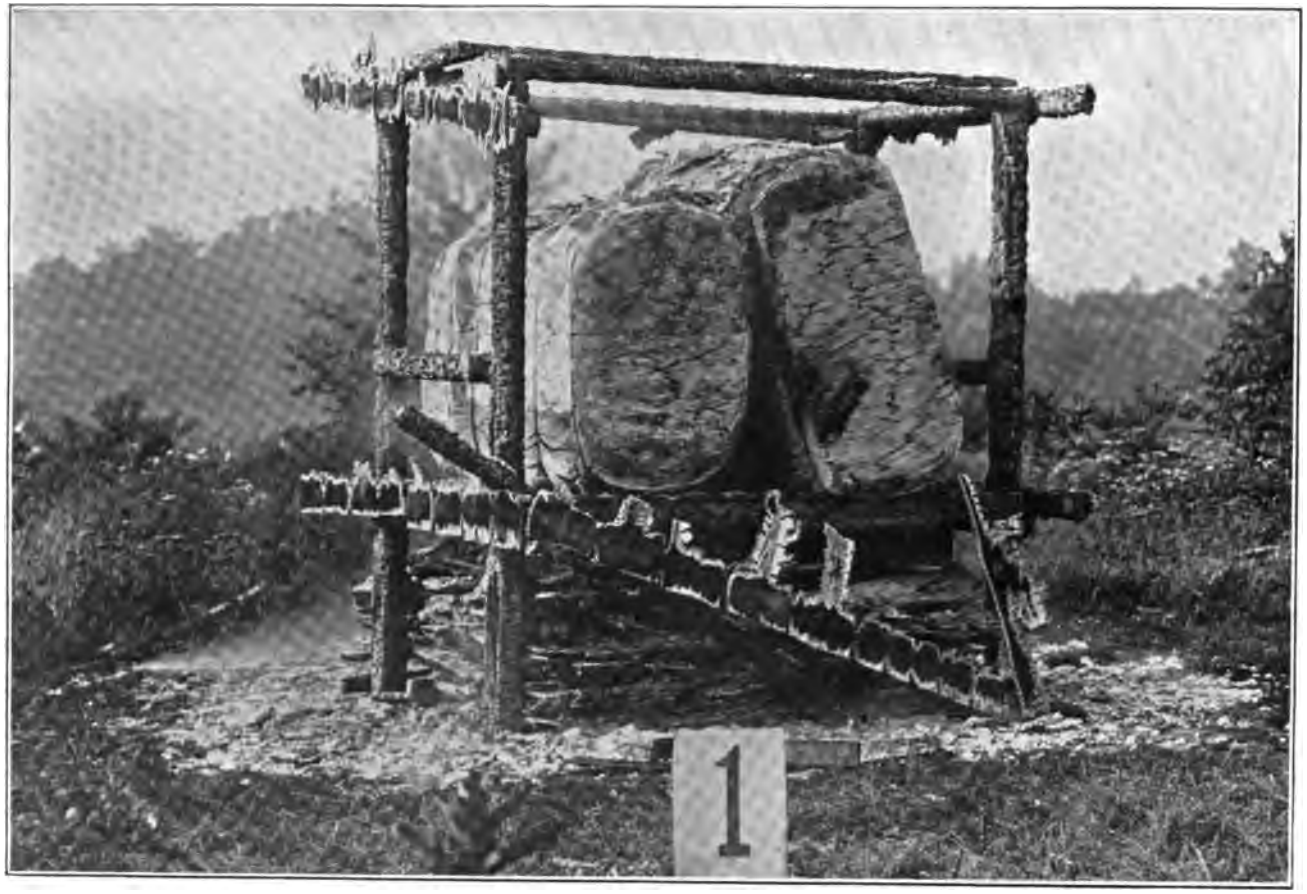
Each roof contained an opening about 12 inches square, to provide for draught in early stages of the fire.

No. 5 hut was constructed and fired with similar materials, but was 8x12x5 feet high, and had beneath it almost one cord of slabs.

For convenience in arranging and identifying the various bales, they were given serial numbers shown on iron tags, secured by No. 10 iron wire passed around the shorter circumference of each bale midway between the ends.

The fire retardant coverings used in this test consisted of burlap soaked in "Fireproofine," which is stated to be a solution of phosphate of ammonia.

An extra length of burlap was used, therefore, for the fire retardant covering of the American bale. After being immersed and kneaded in the solution for about five minutes, it was wrung out, dried in the sun for several hours, hung in a boiler room over night, and sewed on over the bale in a manner similar to that followed in securing the original covering.



GIN BALES AFTER BURNING TWENTY MINUTES.

The covering of the Lowry bale was slipped off and treated with "Fireproofine" at the same time and in the same manner as the covering of the American bale. For the sake of uniformity the Lowry bale was then wrapped in a length of untreated burlap, and the fire retardant covering then slipped over the outside.

The water used in extinguishing the fires was supplied by a steam fire engine, manned by the Chester Fire Department. 650 feet of 2½-inch rubber hose, in good condition, and laid in easy curves, was connected with the steamer through a siamese fitting and two 50 foot lengths of 2½-inch hose. A 1⅛-inch "New York" spray nozzle was employed, held from 20 to 30 feet from the fire, and so used as not to disturb the cotton. 100 pounds water pressure maintained at the steamer.

A light wind from the Southwest prevailed throughout all the tests.

The first photograph of each hut was taken just before the paper roofing was removed.

It should be borne in mind that at the 20, 30 and 60 minute intervals, at which photographs were taken, much smoke and flame were present which the artist has eliminated, that the subjects of the test may be more clearly visible.

Log of Fire Test, Hut No. 1.

(Kept by Messrs. ROBINSON, FISKE and BALCH.)

Hut contained two gin bales placed on edge, having a space about 10 inches between the bales at the bottom.

Bales inclined so as to touch at the top. Bale No. 31 was bound with flat iron bands $^{7}_{8}$ inches wide, and weighed 393 pounds. Bale No. 29 was bound with wire bands (about No. 6) and weighed 540 pounds.

Total amount of Cotton in Hut No. 1, 933 pounds.

P. M.	
3.30	The combustible material under the hut was fired.
3.32	Hut aflame on the inside throughout.
3.33	Roof thoroughly afire outside.
3.34	Ends and rear side of hut thoroughly afire inside and out.
3.35	Hut a mass of flames both inside and out. Fire very hot.
3.38	One or two boards of roof fell in the center.
3.38½	One or two boards of east end fell in.
3.39	Some of the boards of rear side fell in.
3.41	Practically all of rear side, east end, and roof had fallen; west end and weather (south) side well burned through. Framework intact.

GIN BALES AFTER BURNING ONE HOUR.

P. M.

3.43 All but lower edges of sides burned off, framework intact. Cotton bales standing as placed, loose cotton and covering all burned off. Bales subject to severe fire on all sides.

3.45 Framework still intact. Cotton bales as placed.

3.47 Ridge pole fell. Two inside wire bands on bale No. 29 let go.

3.48 Bales settled slightly owing to one of the floor timbers giving way. No material change in position of the bales. Fire still burning briskly.

3.50 Picture taken. Bales standing practically as placed. Most of framework also standing.

3.55 Practically no change, except that bales incline a little more toward the west. Bales in good condition and apparently withstanding the fire well.

3.59 Prop placed against the west side of bale No. 31. Conditions about the same.

4.00 Practically no change. Bale No. 29 expanded some when wire bands were broken.

4.03 Most of framework fell. Position of bales practically unchanged. End band of bale No. 31 nearly off owing to burning away of cotton at this end. Second prop placed against bale No. 31, on account of increased inclination to the west.

4.05 Both bales settled on the fire as the floor timbers had burned away at the ends. Each band on bale No. 31 scraped off when bale settled; bale did not expand as a result.

4.10 Bales resting on a pile of burning slabs, but are inclined a little more. Bales retain their shape well; appearance about the same.

4.13 Bales settled down, and bale No. 29 fell partly out of the fire. One side and one end of this bale was not subjected to quite as severe fire conditions as bale No. 31, owing to its position. Fire still burning quite briskly, particularly between the bales.

4.20 Bales in practically the same position. Bale No. 31 subjected to slightly more fire than bale No. 29. Fire had burned down some, being most severe between the bales and on ends toward the lee side.

4.25 Fire not quite as severe. Bales in practically the same position. Bale in No. 31 still receiving slightly more fire owing to its position.

4.28 Picture taken. Conditions and position of bales unchanged. Bales retain their shape well.

4.30 Water applied from spray nozzle so as not to disturb bales.

4.36 Picture taken.

4.40 Water stopped and bales rolled off.

Note — After the water was applied the distance from the outer burned surface to white cotton was found to be from $\frac{1}{2}$ to $\frac{3}{4}$ inch in Bale No. 29, and about $\frac{5}{8}$ inch in Bale No. 31.

None of the bands on Bale No. 31 were broken, although one slipped off the end as noted.

Two of the inner wire bands on Bale No. 29 were broken during the fire.

GIN BALES, FLAMES HAVING BEEN EXTINGUISHED BY HOSE STREAM AFTER BURNING ONE HOUR.

Log of Fire Test, Hut No. 2.

Hut contained five American bales lying on their sides, three in the lower tier and two above.

Bales were tagged and numbered as follows; No. 4, 276 pounds, No. 5, 276 pounds. No. 6, 280 pounds. No. 7, 284 pounds. No. 8, 290 pounds.

Total amount of cotton in Hut No. 2, 1406 pounds.

P. M.	
3.00	The combustible material under the hut was fired.
3.02	Fire well kindled underneath, but no fire inside hut. Very little wind at this time.
3.05	Fire burning well underneath, but hut apparently not afire inside to any great extent.
3.06	Hut afire, interior bursting into flames.
3.07	Hut thoroughly afire inside, flames bursting through on most all sides.
3.10	Wind freshened somewhat, hut in flames both inside and out. Fire very hot.
3.10½	Some of the roof boards fell in; sides intact.
3.12	Lee side fell in, some remaining parts, all well burned through.
3.13	East end fell in.
3.15	Some of the roof framing fell; weather side of building burned through but standing.
3.16	Supports settled, and all bales tipped back to an angle of about 30 degrees. The ends of the bales were not changed much in form. The sides had flaked off some. Wire retaining the tag may have prevented the fluffing off of burned cotton to some extent, but this is doubtful, as the wire apparently cut through the cotton in the center as bale expanded in burning.
3.20	Picture taken. Bales in about the same position and condition. Ends were toward the wind, which was not strong enough to blow off the burned cotton to any extent.
3.25	Roof timbers fell. Cotton bales in about the same condition. Top pieces and two uprights fell, leaving two uprights standing. Two of the wooden cross pieces or girders at rear gave way, and the three lower bales rested on the fire at rear. The bales all tilted towards rear. It was noticeable at this time, and also during the remainder of the test, that the wire encircling each bale to which the tags were attached, may have tended to hold the bale together by preventing the outside laps from unwinding. This effect was, however, slight, it being apparent that there was no strain on the wire, nor did there appear to be any great tendency of the laps to unwind.
3.32	Owing to the tilting of the bales, and the danger of the two upper bales falling off, two long wood braces were used at rear, pressing against the ends of the bales.
3.35	The remaining uprights fell. Good hot fire underneath with plenty of fuel burning.
3.38	Bales have flaked some and enlarged slightly, but have not changed their shape materially. Length appears not to have changed, and the swelling is apparently simply due to the burning of the outer laps.

HUT No. 2, CONTAINING FIVE AMERICAN BALES BEFORE FRONT WAS REPLACED AND FIRE STARTED.

P. M.

3.40 Rear horizontal timber falls, and but for the wood props the two top bales would fall off.

3.45 If anything, the two top tilted bales are under more severe fire conditions than if they had stayed in place, as they tilted leeward, and the flames from fire below play more directly upon them.

3.48 Bales remain in about the same condition and hold their shape well. One bale (No. 8) falls off at rear. In attempting to push it on by means of a wooden beam, the bale is somewhat torn. The other upper tier bale (No. 5) falls off about ½ minute later. Both bales well on the fire, resting on the ground leeward side about two feet away. The left hand lower bale (No. 7) also rolls off on the left hand side, and rests on ground against the burning embers. Middle lower bale (No. 6) rolls slightly to the left, and rests directly on fire. Right hand bale (No. 4) rolls slightly to the right, and rests on ground at rear. Good hot fire.

3.55 The two bales at rear are now practically out of the fire and only burning slightly.

3.55 Picture taken from front.

3.58 Picture taken from right side.

4.00 Water turned on from spray nozzle.

4.05 Stopped water and picture taken. Bales were then rolled apart and wet down further.

Examination after fire showed cotton to be charred for a depth of ½ to ¾ inch from surface.

Log of Fire Test, Hut No. 3.

Hut contained five Lowry bales lying on their sides, three in the lower tier and two above.

Bales were tagged and numbered as follows: — No. 16, 258 pounds. No. 17, 247 pounds. No. 18, 241 pounds. No. 20, 264 pounds, and No. 24, 236 pounds. Total amount of cotton in hut, 1,246 pounds.

P. M.

2.30 The combustible material underneath the hut was fired.

2.32 Fire well kindled underneath, but little or no fire inside hut.

2.35 Hut thoroughly afire inside.

2.37 Hut a mass of flames inside, bursting through on most all sides.

2.40 Some of roof boards fell in, and also some of rear side boards.

2.43 End and rear sides fell in; framework intact.

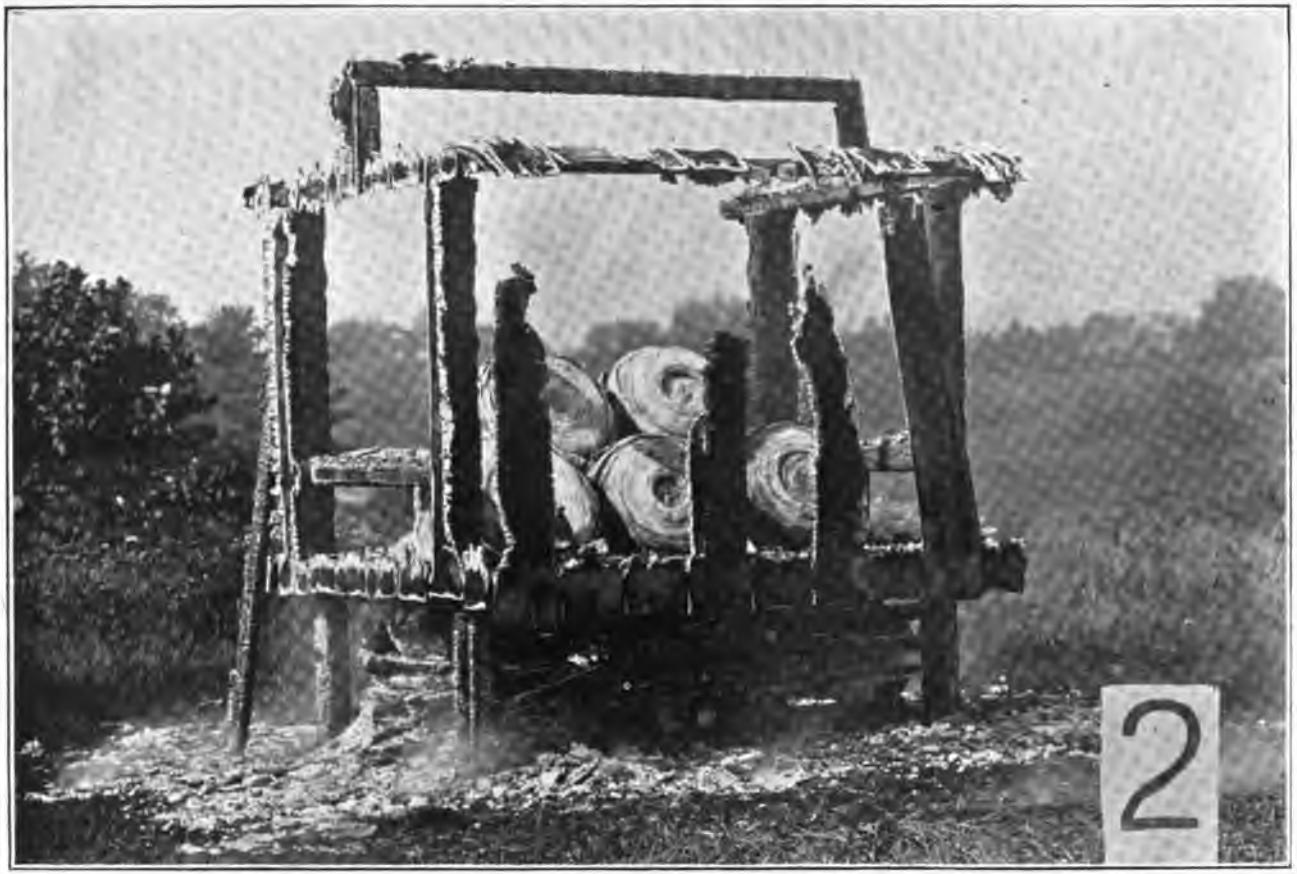
2.45 East end fell. Windward side well burned through. Cotton bales intact and in position.

2.47 Most of all sides down. Bales in position and apparently not seriously affected.

2.48 Bales dropped together into fire and rested on burning pile of slabs. Condition of cotton unchanged.

2.50 Picture taken. Bales in some position, ties not broken.

2.53 The lower tie on Bale No. 24 gave way without much elongation of bale.



AMERICAN BALES AFTER BURNING TWENTY MINUTES.

P. M.

2.54 & 2.56 Bands on Nos. 16 and 17 gave way.

2.57 Bands breaking and ends of bales bulging and flaking off.

3.00 Bales settling, band on No. 18 broken, bales well down on fire. One band on each bale broken except No. 20. Bales very ashy in appearance, keeping their shape to windward but breaking up to leeward.

3.08 Remaining bands broke on Nos. 16 and 17 and 24. These bales fall apart.

3.13 No. 18 four feet six inches in length.

3.15 All bales except No. 20 opened up and well down in fire.

3.22 Leeward end of No. 24 pushing way out.

3.24 No. 18 six feet in length.

3.28 Photograph taken.

3.30 Water from spray nozzle turned on.

3.34½ Spray turned off for taking photograph at 3.35½.

3.36½ Spray turned on again.

3.38½ Spray turned off.

3.41 Bales partially rolled apart.

3.41½ Spray turned on to quench remaining traces of fire.

3.42 Spray stopped, No. 20 rolled out. Others all loose and had to be gathered up in sections. No. 18, 9 feet in length. No. 20, charred portion one-half inch in thickness; diameter of other bales about 15 inches. Bands burst both at buckles and at middle.

3.46 Spray on for half minute to drown live embers yet remaining.

Log of Fire Test, Hut No. 4.

Hut contained two compressed square bales lying on their flat sides and close together. Bales were tagged and numbered as follows: — No. 26, 545 pounds. No. 27, 551 pounds. Total amount of cotton in hut, 1,096 pounds.

P. M.

2.00 The combustible material underneath the hut was fired.

2.02 Fire well kindled underneath and inside hut.

2.03 Hut thoroughly afire inside.

2.05 Hut interior a mass of flames, bursting through on all sides.

2.07½ Some of the roof boards fell in.

2.09 Some of the end and rear side boards fell in.

2.13 Framework standing, but sides mostly down.

2.15 Cotton bales intact. No bands broken.

2.17 Roof timber fell in; floor supports intact.

2.20 Picture taken. Practically no change in conditions.

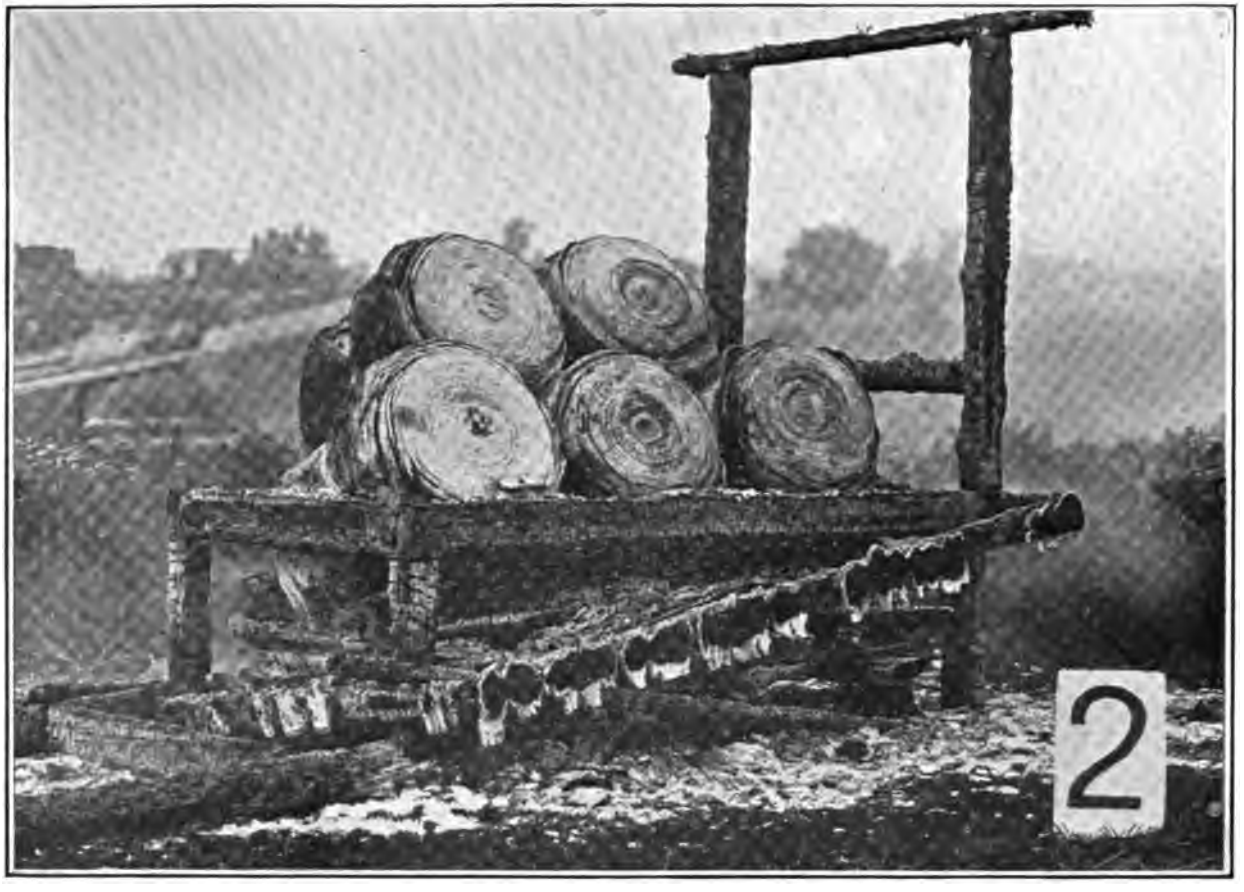
2.22 One of floor timbers gave way; bales and bands intact.

2.25 Four corner posts and top iron piece standing. Large amount of fuel still burning underneath. No bands burst. One slipped off at end of bale No. 26. Bales hold their shape. One wooden grid at center falls.

2.29 Top roof piece fell on top of bales.

2.32 Another grid falls. Hot fire.

2.32 One corner post falls. Bales hold their shape.



AMERICAN BALES AFTER BURNING THIRTY MINUTES.

P. M.

2.36 Bales sag some as they are supported at ends only.

2.40 Rear support part gone, and bales nearly resting on fire at rear.

2.41 Another support gone, and bales rest on fire.

2.45 An end tie on each bale slipped off on windward side.

2.48 Bales about half on fire. Fire quite well burned out and not much flame, but fire still very hot.

2.52 Bales practically resting on embers.

2.58 Bales settled a little more. They hold their shape well, and no bands have burst. Picture taken.

2.59 One bale rolled over.

3.00 Water turned on.

3.06 Water stopped. Picture taken.

3.08 Bales rolled apart and more water used to make sure the fire was extinguished.

3.11 Water stopped and bales carted away soon after.

Bales were not badly burned, and held their shape well. No bands burst.

Log of Fire Test, Hut No. 5.

Hut contained one gin bale, flat side down, one recompensed bale on edge, two American bales, one with original covering, and one with fire retardant extra covering, two Lowry bales, one with original covering and one with fire retardant extra covering, and one bale of dry goods (2,000 yards). Round bales and bale of dry goods were all placed on their sides.

Bales were tagged and numbered as follows: No. 30, gin bale, 342 pounds. No. 25, recompressed bale, 577 pounds, No. 2, American bale, original covering, 282 pounds. No. 34, American bale, with fire retardant extra covering, 267 pounds. No. 22, Lowry bale, original covering, 257 pounds. No. 13 Lowry bale, with fire retardant extra covering, 257 pounds. No. 33, bale of dry goods, 290 pounds. Total amount of cotton in hut, 1,982 pounds.

P. M.

5.30 The combustible material underneath the hut was fired.

5.34 Fairly well kindled underneath.

5.37 Fire starting inside of hut.

5.39 Inside of hut thoroughly afire, also roof and east end.

5.40 Interior and most of exterior thoroughly afire.

5.41½ Some of the roof boards fell in.

5.44 Some of east side fell, roof nearly all in.

5.45 Rear side about half down.

5.46 Rear and east sides nearly all down and remaining sides well burned through but standing.

5.49 Ridge pole fell.

5.50 Sides mostly down. Bands on Lowry bale No. 13, gave way, one band a little before the other.

5.52 One band on Lowry bale No. 22, gave way.

5.52½ Picture taken. Second band on Lowry bale No. 22, gave way. Bale of dry goods expanded considerably. American bales expanded on sides, but ends little changed. Lowry bales elongated.

AMERICAN BALES AFTER BURNING ONE HOUR, FRONT VIEW.

P. M.

5.57 Sheet of burned cotton fell from American bale No. 34.

6.00 Lowry bales considerably elongated, also bale of dry goods. Sides of American bales puffed up, but the general form of these and of the square bales not changed much.

6.05 Sides of American bale No. 2 peeled off; bales on west side practically resting on bed of burning slabs. American bale No. 34 not subjected to as severe a fire owing to its windward position.

6.06 Lowry bale No. 13 elongated more.

6.10 Conditions about the same. Square bale bands all intact.

6.11 Picture taken.

6.13 East side of floor framing fell in.

6.15 All bales had settled so as to rest on a bed of hot coals; flames materially reduced. Lowry bales badly elongated. American bales burned on the outside, but not changed in form much. Square bales both intact.

6.20 Condition about the same; fire not as severe.

6.25 Condition about the same; fire a little lower.

6.28 Picture taken.

6.30 Relative positions and conditions of bales not materially changed, except that Lowry bales elongated more. Water applied in the form of a spray.

6.35 Photograph taken.

6.40 Spray stopped and Nos. 25 and 30 rolled out. Spray was turned on again to entirely quench embers. No. 34 charred $\frac{3}{4}$ of an inch in depth. American bales 2 feet, 8 inches long, and 1 foot, 7 inches in diameter. Both the ordinary and fire retardant coverings entirely consumed.

No. 13 (Lowry) bale, 9 feet, 6 inches long, and 1 foot, 5 inches in diameter.

No. 22 (Lowry) bale, 11 feet long, and 1 foot, 4 inches in diameter.

No. 25 (Recompressed) bale, 4 feet, 10 inches x 4 feet x 1 foot, 9 inches. One band only broken ($\frac{7}{8}$ inch strap iron), other bands very tight. Bale not much burned on one side.

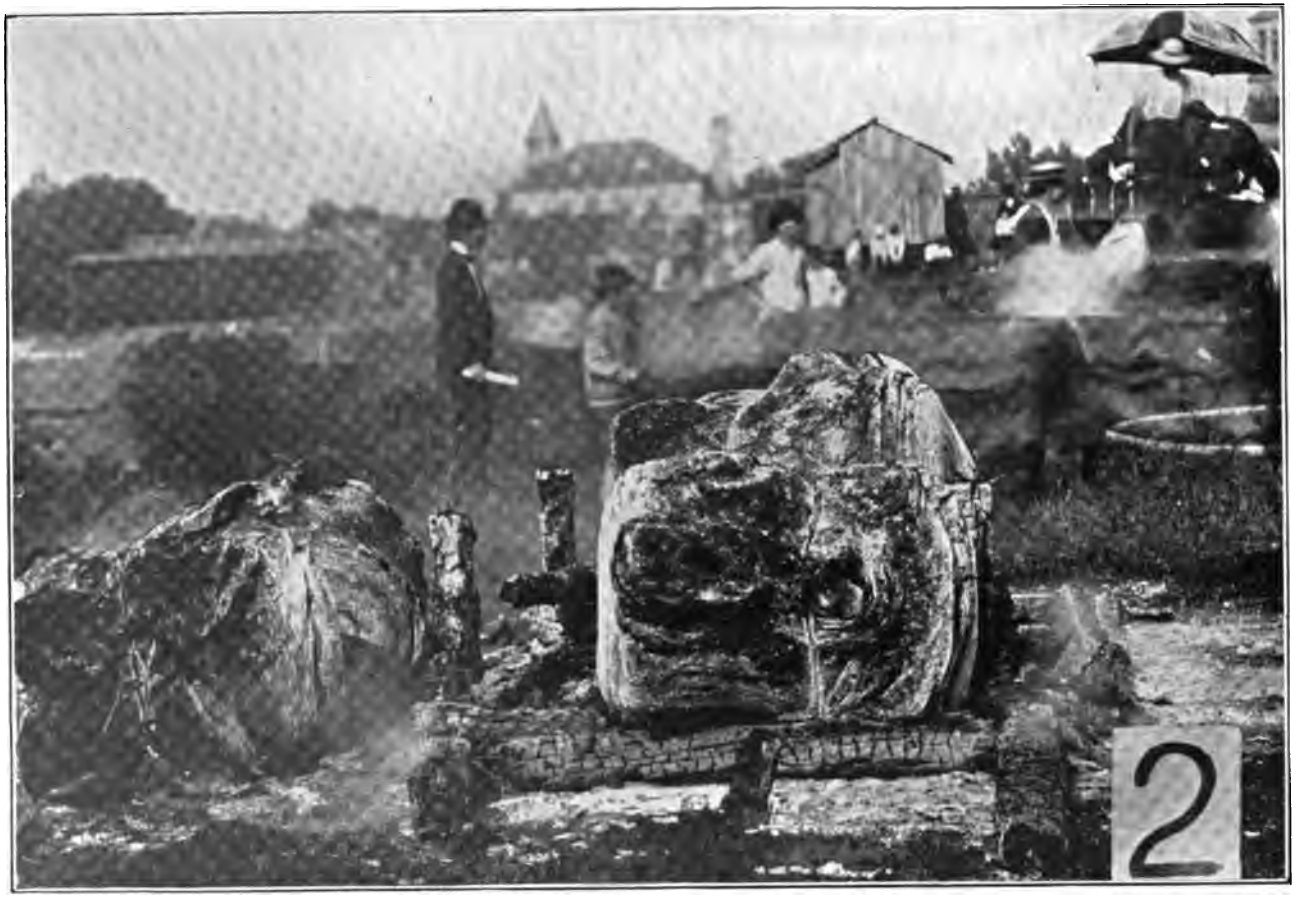
No. 30 (Gin) bale ($\frac{7}{8}$ inch) bands, very loose after fire.

General Notes on Fire Test.

The fires in huts No. 1, 2, 3 and 4, burned quite uniformly, and the light wind did not affect the comparative results.

It has been suggested that the wire placed about each bale to which tag was attached may have confined the cotton to some degree, particularly in preventing the American bale unrolling. However, test observations did not emphasize this point, and we judge this effect (if existing to any extent) largely counter-balanced by the tendency of the wire to burrow into the cotton.

Mr. Griswold is informed by Wallworth & Sons that upon opening these bales (American) they could not observe that these wires had influenced the results.



AMERICAN BALES AFTER BURNING ONE HOUR, SHOWING BALES ROLLED OFF, SIDE VIEW.

IMMERSION TEST.

In charge of Mr. GRISWOLD assisted by Mr. TAYLOR.

The several types of bales to be held under water for 48 hours, and the extent each had absorbed water noted.

Two cylindrical dye vats at the mill of Shaw & Ezrey were used for these tests. The bales were weighed and their dimensions taken before placing in the vats. The length of each bale was noted, and three measurements of circumference were taken with a tape on each bale, one measurement near each end, and one midway between the ends. The vats were then drained and the bales placed on the bottom.

Horizontal lengths of 3 x 4 inches and 4 x 4 inches yellow pine were nailed across the vats, 12 inches from the top to keep the bales submerged, all being of such a density as to float when dry. Water was then run into the vats, the time of starting the flow, and the time when the cotton was completely covered being noted in each case. The vats were filled to overflowing, and a small stream left running into each to provide against reduction of level due to absorption. The vats overflowed continuously throughout the tests, and the bales were covered by about 12 inches of water when the vats were full and the bales were floating up against the retaining braces.

Both night and day watchmen were kept on duty.

It was the intention to submerge all the bales for 48 hours, then allow each to drip for 15 minutes and then take the weights. On account of the difficulty encountered in handling the gin bale, however, this plan could not be carried out.

No scale of sufficient capacity to weigh either of the square bales when wet could be obtained, and it was necessary to cut open both of these bales in the dye house and weigh the cotton in sheets. A considerable portion of the water absorbed by the gin bale was squeezed out by the tackle used in lifting it, and by the blows it received in swinging against the side of the vat while being removed. The same is doubtless true of the recompressed bale, but in a lesser degree. See note following data on gin bale.

AMERICAN BALES, FLAMES HAVING BEEN EXTINGUISHED BY HOSE STREAM AFTER BURNING ONE HOUR.

Vat No 1.

Gin Bale No. 32.

Water started	Tuesday	10.50	A. M.
Bale covered	"	11.09	"
Drain opened	Thursday	10.52	"
Bale uncovered	"	10.55	"
Water all off	"	11.02	"

Average time of submersion 11.00 A. M. Tuesday to 10.59 A. M. Thursday, 47 hours 59 minutes.

Gin Bale

Weight dry	507 pounds.	
Length dry	5 feet 2 inches.	
Circumference measured at three points as described dry	11 " 2 "	(Band off this end.)
	11 "	
	10 " 2 "	
Length wet	5 " 6 "	
Circumference wet	12 "	
	11 "	
	11 " 8 "	

Bale opened at 2.40 P. M. Thursday, and cotton and covering weighed in 15 packages as follows:

No. 1	137 pounds.	No. 9	119 pounds.
2	83 "	10	113 "
3	147 "	11	135 "
4	84 "	12	80 "
5	100 "	13	110 "
6	101 "	14	95 "
7	121 "	15	21 "
8	112 "		
Total,	1,558 pounds.	Weighing finished	3.22 P. M.

Packing No. 15 contained the covering and bands. Mr. GRISWOLD estimated that 98 per cent. of the cotton in this bale was saturated with water.

Twenty-seven hours after starting the test this vat was inspected and the bale found to be resting on the bottom. A moderately distributed evolution of air was noted at this time.

Note — The dimensions of this bale were approximately $5\frac{1}{2}$ x $3\frac{1}{2}$ x 2 feet, giving a volume of about $38\frac{1}{2}$ cubic feet. Assuming that it must have weighed 65 pounds per cubic foot in order to sink, the bale at the time of sinking must have weighed about 2,500 pounds.

At the end of the test, when this bale had been sunk for about 47 hours, evolution of air was still noted, the rate being somewhat less than that noted at the end of 27 hours. The bale was apparently, therefore, absorbing water throughout the entire test, and, if so, must have weighed considerably more than 2,500 pounds at the end. This conclusion is borne out by the difficulty met in raising the bale from the vat.

HUT No. 3, CONTAINING FIVE LOWRY BALES BEFORE FRONT WAS REPLACED AND FIRE STARTED.

Vat No. 2.

Bale No.	Description.
3	**American.**
15	**Lowry.**
28	**Recompressed.**
Water started Tuesday	11.12 A. M.
Bales covered "	11.35 "
Drain opened Thursday	11.12 "
Bales uncovered "	11.15 "
Water all off "	11.19 "

Average time of submersion 11.24 A. M. Tuesday to 11.17 A. M. Thursday, 47 hours 53 minutes.

Vat inspection at end of 27 hours showed:

American bale . . . { Evolution of air quite fast considering area. / Evolution all from one point where covering was injured.

Recompressed bale . . Evolution slow and distributed.

Lowry bale . . . . . No demonstration. All bales floating up against braces.

Vat inspection at end of 47 hours showed all bales floating as before against braces.

American bale . . . . Evolution about the same as before.

Recompressed bale . . " " " " "

Lowry bale . . . . . Evolution moderate and intermittent.

Weights and Dimensions.

Lowry Bale.

	Dry.	Wet.	Remarks.
Weight	260 pounds.	312 pounds.	Weighed 12.25 P. M. Thursday.
Length	39 inches.	41½ inches.	
Circumferences .	5 feet	5 feet	
	5 "	5 "	
	5 "	5 "	

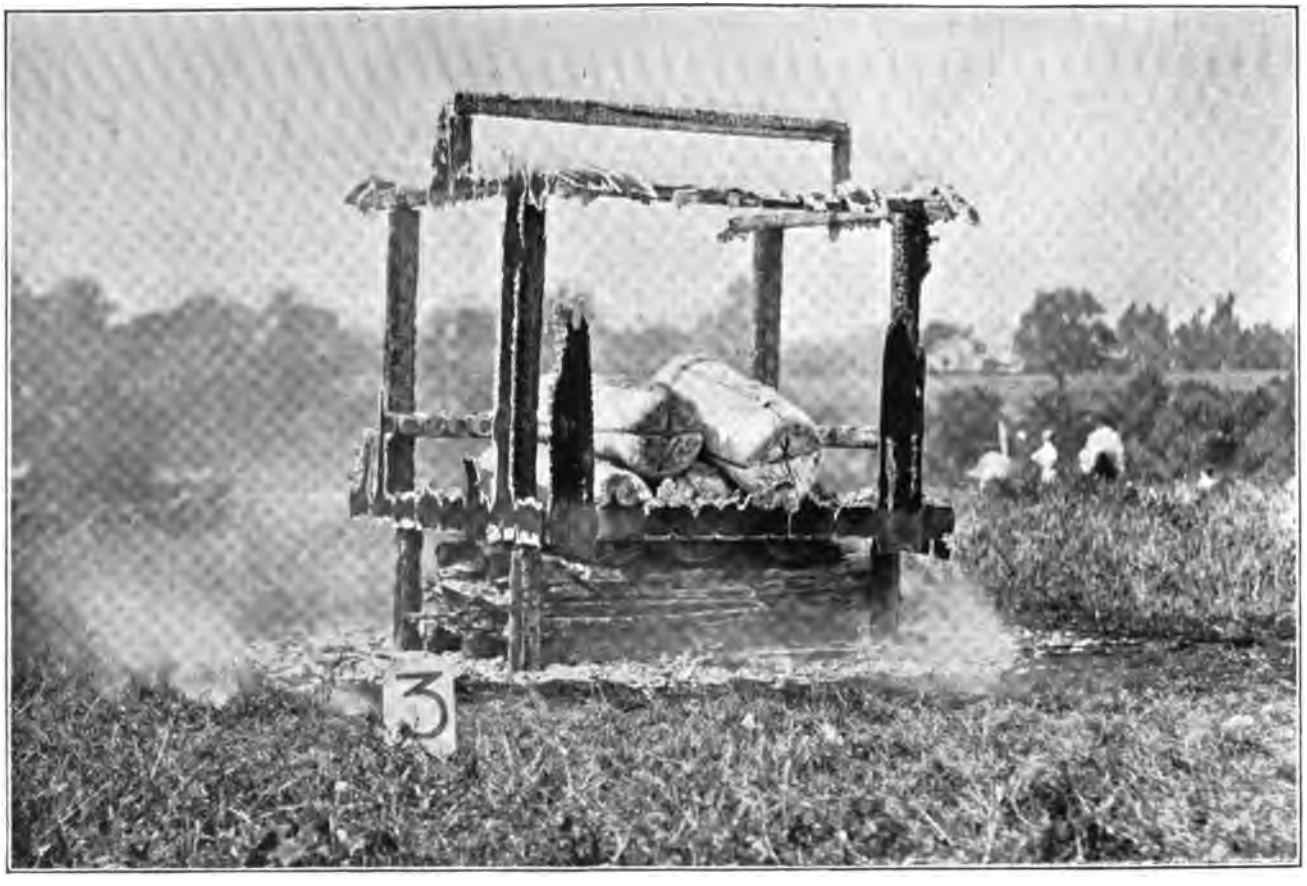
American Bale.

	Dry.	Wet.	Remarks.
Weight	270 pounds.	366 pounds.	Weighed 12.20 P. M. Thursday.
Length . . .	35 inches.	35 inches.	
Circumferences .	5 feet 9 inches.	6 feet.	
	6 "	5 " 11 inches.	
	5 " 10 "	6 "	

Recompressed Bale.

	Dry.	Wet.
Length . . .	5 feet 9 inches.	5 feet 11 inches.
Circumferences .	8 feet 8 inches.	8 feet 6 inches.
	8 " 4 "	9 "
	8 " 8 "	8 " 5 "

Weight dry 560 pounds.



LOWRY BALES AFTER BURNING TWENTY MINUTES.

Wet bale opened and weighed in 11 packages between 1.58 and 2.35 P. M. Thursday. Weight as follows:

No. 1	152 pounds.	No. 7	131 pounds.
2	163 "	8	157 "
3	111 "	9	148 "
4	122 "	10	108 "
5	94 "	11	122 "
6	160 "		
Total			1,468 pounds.

Some water was also lost from this bale in handling. This bale absorbed considerably less water than the gin compressed bale, however, as, in spite of its greater initial density, it did not sink. Mr. Griswold stated that nearly all of the cotton in this bale was moist, but not saturated as in the gin bale.

The conditions of these tests were, of course, quite different from those which would obtain where cotton is thrown into water. The gin bale in the latter case would undoubedly have required a much longer time to sink.

BURROWING TEST.

To note the extent the several bales are susceptible to fire burrowing within the bale.

Tests conducted at Underwriters' Laboratories, Chicago, in charge of Messrs. Robinson and Taylor.

A brick hut, 6½ feet long, 3 feet 10 inches wide, and 3 feet high to the square and having a metal roof was erected for these tests in the yard at the Laboratories. The front of the hut was closed with sheet metal during each test.

The hut was sufficiently tight to pretent severe draughts in all of the tests, although the joints allowed the circulation of sufficient air to support combustion in all cases.

A bolt head ¾ inch square and weighing 3½ ounces was heated a bright red and the flat side placed against the bale in each of the tests made. The hut was closed immediately after the application of the bolt head, and all observations were made through a small opening at one end, thus avoiding the admission of severe draughts.

A sunbeam reflected on a mirror was used in making the observations whenever possible.

Test No. 1.

AMERICAN BALES.

Bale No. 9 placed on its side and Bale No. 10 on end. Bales 22 inches apart.

Sept. 9th. 10.23 A. M. Bolt head applied to the middle of the side bale No. 9.

Burlap blazed up around the bolt head, which retained color for 7 minutes, at

LOWRY BALES AFTER BURNING THIRTY MINUTES.

which time the burlap was burned through and charred in a circle about 3 inches in diameter.

Sept. 9th. 10.26 A. M. Bolt head applied to the center of the upper end of bale No. 10. No appreciable difference in action from that noted above.

Sept. 9th. 1.00 P. M. Smoke started and increased in volume, issuing around the end of the roof.

Sept. 10th. 11 A. M. Observation made through peak hole. The covering was apparently all off of Bale No. 9; hole noted in bale where iron was applied but bolt head not visible. Bale still burning and hut filled with fairly thick smoke. Bale No. 10 apparently uninjured.

Sept. 11th. 9 A. M. Observation made through peak hole. Smoke ceased. Bale No. 9 almost entirely destroyed. Portion remaining about 22 inches long by 13 inches high by 6 inches thick, standing on edge and resting in a bed of flaky ashes. Mass was very hot, but there was no indication of incandescence and no smoke.

Bale No. 10 was uninjured with the exception of the charred circle in the burlap around the bolt head.

Sept. 13th. Hut opened in the presence of Mr. GIBSON of Walburn Swenson Company, representing the American Cotton Company.

Bale No. 9 was totally destroyed, ashes about 3 inches deep and covering a space of about 3 x 4 feet. One end of the burlap covering and a few small pieces next to the bricks supporting the bale were found charred but not destroyed.

Fire had eaten about one inch into the cotton on the end of the bale No. 10 and died out.

Top removed from hut and remains of Bale No. 9 photographed.

Test No. 2.

LOWRY BALE NO. 14, PLACED ON ITS SIDE.

Sept. 15th. 10.01 A. M. Hot bolt head applied to middle of the side about one inch from iron tie. Fire blazed up and burned about a 3-inch circle in burlap, iron showed color for about 7 minutes. Cotton around iron was incandescent at the end of 7 minutes. At the end of 15 minutes fire had worked into the cotton below the burlap, charring this from underneath and burning out through it about 1 inch from the edge of the 3-inch burned circle about the bolt head.

Sept. 15th. 10.16 A. M. Hut closed up with bale still smoking and burlap and cotton incandescent at the point mentioned.

Sept. 16th. 9.00 A. M. Observations made and fire found to have died out.

Three additional attempts similar to the above were made on Sept. 16th and 17th to start fire in the side of the bale, applying the iron in a new place each time. All were unsuccessful, the fire in each case extending into the cotton to a depth of about $\frac{1}{4}$ inch, and spreading over an area of from 3 to 4 inches in diameter and then dying out. It is believed that in none of the trials did the fire last more than 20 minutes after the application of the iron.

LOWRY BALES AFTER BURNING ONE HOUR.

Test No. 3.

LOWRY BALE NO. 14, PLACED ON END.

Sept. 19th. 9.40 A. M. Hot bolt head applied on the loose cotton slightly to one side of the crossing of the ties. Cotton and burlap blazed for four minutes, leaving the cotton round the bolt head incandescent. The bolt head showed color for about 9 minutes, which was longer than in the previous tests, due probably to the iron being surrounded with incandescent cotton.

The hut smoked freely all day, but cotton was not examined owing to the lack of sun.

Sept. 20th. 9.00 A. M. Observations made. Hut smoking freely. Burlap burned off both ends of bale and off sides for about 10 inches from each end. Burlap still in place around middle of bale. Believed that fire worked down through loosely compressed core and started upward from the bottom, causing appearance noted. Bale tipped to one side and leaning against wall of hut.

Sept. 20th. 11.00 A. M. Inspected and found still hot and smoking freely.

Sept. 21st. 11.00 A. M. Sunday. Hut observed, but no smoke noted.

Sept. 22d. 10.30 A. M. Hut still warm. Opened and remains of bale photographed. Lump of charred cotton, weighing about 2 pounds removed from ashes and split open. Mass was too hot to touch with bare hand. Cotton was black throughout, like charcoal. The lump was reduced to ashes during the day.

Test No. 4.

AMERICAN BALE NO. 10, PLACED ON END.

Sept. 24th. 10.00 A. M. Hot bolt head applied to the opposite end to that in test No. 1. Burlap blazed up for about 2 minutes as in first test. Cotton then incandescent below and around the iron, which retrained its color for 7 minutes. During the following 15 minutes all appearance of fire or incandescence disappeared.

Mr. Taylor remained in the hut about 30 minutes.

Sept. 25th. 8.00 P. M. Burlap found burned in a 4-inch circle and bolt head sunk flush in the cotton. Fire had eaten into core of bale about 4 inches, although bolt head did not follow the fire more than 1 inch.

Test No 5.

AMERICAN BALE NO 10, PLACED ON END.

Sept. 25th. 8.26 P. M. Hot bolt head applied to the same end, but midway between the center and edge. Iron sunk into cotton a little faster than usual, blazing for $2\frac{1}{2}$ minutes. Iron retained color for 9 minutes, being imbedded in incandescent cotton. Cotton still smoking at the end of 15 minutes, but not very active.

Sept. 25th. 10.30 P. M. No smoke observed.

Sept. 26th. 9.00 A. M. Hut smoking freely, but no sun for examination of bale. Smoked freely during the morning, but diminished considerably at 5 P. M.

LOWRY BALES. FLAMES HAVING BEEN EXTINGUISHED BY HOSE STREAM AFTER BURNING ONE HOUR.

Sept. 27th. 9.30 A. M. Observation made and covering to bale found destroyed. Bale still burning and ash flaking off sides. Bale about 16 inches in diameter and still standing. Ashes had appearance of being about 2 inches thick. Bale very hot and not disturbed. Hut smoking moderately at 4 P. M.

Sept. 28th. 11.00 A. M., Sunday. Hut smoking slightly.

Sept. 29th. 9.00 A. M. No smoke. Observation made and bale found still upright, about 10 inches in diameter, and of the same general appearance as before. Bale very hot, but not smoking.

Sept. 30th. 10.00 A. M. Observation made and bale found to have been reduced to a pile of ashes about 16 inches high, and still hot. Hut not opened because of rain.

Oct 1st. 9.00 A. M. Hut opened and remains of bale photographed. Appearance not materially changed from that of previous day. Ashes removed and a lump of charred cotton, weighing about 10 pounds removed and photgraphed. It was found to be burning slowly on the outer surfaces, the cotton on the inside being charred and turned black clear through.

Test No. 6.

GIN BALE.

Gin bale received from St. Louis, Mo., weighing 430.5 pounds. Jute covering in good condition. Bale placed on edge, narrow side up.

Oct. 1st. 12.12 P. M. Hot bolt head placed in the center of the upper surface. Covering and cotton blazed up for 2 or 3 minutes, but flash did not spread.

Oct 1st. 1.00 P. M. Hut smoking moderately. Fire apparently spread faster than in the case of the round bales.

Oct. 1st. 5.00 P. M. Fire had spread nearly across the top of the bale, and over an area of about 20 inches wide. Fire had reached the loose cotton on one side; was smoking freely, but there were no indication of a flash fire.

Oct 2nd. 9.30 A. M. Hut was smoking freely, solder on joints of metal roof found melted and paint blistered, indicating considerably more heat than in previous tests on round bales.

The end of bale next to observation hole was not burned, although the high temperature indicated that the bale was burning over a considerable area in the center.

Hut smoked freely all day, but smoke diminished somewhat toward evening.

Oct. 3d. 10.00 A. M. No smoke. Cotton examined and found entirely reduced to ashes, which were still warm.

Photograph taken on October 6th, owing to lack of satisfactory light before this.

Test No. 7.

RECOMPRESSED BALE.

Recompressed bale received from St. Louis, Mo., weighing 140.5 pounds. Jute covering in good condition, but considerable loose cotton at one end. Bale placed on edge, narrow side up.

HUT No. 4, CONTAINING TWO RECOMPRESSED BALES, BEFORE FRONT WAS REPLACED AND FIRE STARTED.

Oct. 7th. 9.30 A. M. Hot bolt head placed in the center of the upper surface. Covering and cotton blazed up, flames lasting about 3 minutes. Iron retained color about 6 minutes. At the end of 30 minutes fire had burned over a circle about 4 inches in diameter, was smouldering slowly, but no fire had flashed over the surface of the bale.

Oct. 7th. 10.30 A. M. Iron had settled into bale about $^1/_4$ inch and burned area on top increased to 8 inches in diameter.

Oct. 7th. 1.30 P. M. Strip about 10 inches wide was burned nearly across the bale, smouldering slowly.

Oct. 7th. 5.00 P. M. Smoke and heat increasing. Fire had reached the end nearest observation hole but exact spread could not be ascertained.

Oct. 8th. 9.00 A.M. Bale found burned on all sides so that iron bands were quite loose. Bale apparently about $^1/_3$ burned. Fire very hot, but was without flame Very little smoke.

Oct 8th. 4.30 P. M. Appearance about the same. Bale apparently over $^1/_2$ consumed, bale leaning over to one side of the hut. Very hot but with little smoke.

Oct. 9th. 11.30 A. M. Bale totally consumed. Ashes quite warm, but fire had probably burned out some hours previous to the examination. Photograph taken.

SUMMARY.

AMERICAN BALES:

Bale No 9. was totally consumed from first application of the hot bolt head to the *side* of the bale. The fire extended slowly over the entire outer surface of the bale, the burrowing effect being uniform from all sides so far as could be observed.

Bale No. 10. Fire not retained in two applications of the hot bolt head to opposite *ends*. Retained the fire and consumed bale when hot bolt was applied midway between the center and the edge of the end. Tests indicate that these bales will retain fire on the sides much more readily than on the ends.

Bale No. 9 consumed in approximately 3½ days.
Bale No. 10 consumed in approximately 6½ days.

LOWRY BALES:

Bale No 14. Fire not retained in four applications of the hot bolt to the *side* of this bale. Bolt not applied in the same place in any of the above trials.

Bale No. 14 was totally consumed from first application of the hot bolt head to the end of the bale slightly to one side of the crossing of the ties. The fire extended slowly to both ends of the bale, apparently burrowing down through the core.

Tests indicate that these bales will retain fire on the ends much more readily than on the sides.

RECOMPRESSED BALES AFTER BURNING TWENTY MINUTES.

Bale No. 14 withstood four applications of the hot bolt head to sides.

Bale No. 14 consumed in a little over 3 days when fired at end.

GIN BALE: (430.5 lbs.)

Was totally consumed from the first application of the hot bolt head to the side. The fire extended slowly over the entire outer surface of bale, the burrowing effect being apparently uniform from all sides.

Bale totally consumed in approximately 1½ days.

RECOMPRESSED BALE: (140.5 lbs.)

Was totally consumed from the first application of the hot bolt head to the side. No material difference noted in the action of the fires in the gin and recompressed bales, except that fire was slower in the recompressed bale.

Bale totally consumed in approximately 2 days.

REMARKS.

It could not be ascertained to what extent the fire entered or burrowed into the bales, as the spread of the fire, although slow, was much more rapid on the outside. No flames were noted in any of the tests after the first two or three minutes and in no case did the fire flash over the surface.

Each bale being surrounded by a good supply of air at all times the fire apparently followed the path affording most ready combustion, the only exception being noted in test No. 3, where the fire is asssumed to have burrowed through the core of the Lowry bale.

RECOMPRESSED BALES AFTER BURNING ONE HOUR.

REPORT OF SALVAGE

BY J. WALLWORTH & SONS.

NOTE — Gross weight of bales includes ties and coverings. Salvage weight is for cotton only. Hence, no attention has been given to the tare.

ACCOUNT OF BALES FROM FIRE TEST.

Hut No. 1.

2 GIN BALES, sound weight,—933 lbs. at .09 $\frac{9}{16}$				$89 22
Salvage.				
Sound dry cotton,—470 lbs. at .09 $\frac{9}{16}$			$44 95	
	Wet weight.	Dry weight.		
Choice burnt picking,	361 lbs.	152 lbs. at .03 $\frac{3}{4}$	5 70	
			$50 65	
Expense.				
Expense to pick	$1 03			
Expense to dry	1 14		2 17	
		Net monetary salvage .		48 48
		Loss		$40 74
		Monetary salvage . . .	54.3%	

Total weight of sound cotton . . . . . 933 pounds.
Sound dry weight . . . . . 470 pounds.
Burnt pickings . . . . . 152 "
622 "
Cotton consumed . . . . . 311 pounds.
Salvage by weight . . . . . 66 $\frac{2}{3}$%
Sound dry cotton 50.37%

Hut No. 2.

5 AMERICAN BALES, sound weight,— 1406 lbs. at .09 $\frac{3}{4}$ . . .				$137 09
Salvage.				
3 bales remaining in hut.				
Dry white cotton,—561 lbs. at .09 $\frac{3}{4}$			$54 70	
	Wet weight.	Dry weight.		
Choice burnt pickings,	288 lbs.	131 lbs. at .03 $\frac{3}{4}$	4 91	
2 bales rolled out of hut.				
Dry white cotton,— 396 lbs. at .09 $\frac{3}{4}$			38 61	
	Wet weight.	Dry weight.		
Choice burnt pickings,	132 lbs.	75 lbs. at .03 $\frac{3}{4}$	2 81	
			$101 03	

RECOMPRESSED BALES. FLAMES HAVING BEEN EXTINGUISHED BY HOSE STREAM AFTER BURNING ONE HOUR.

Expense.

Cost to pick 5 bales	$2 21		
Cost to dry	1 53	3 74	
Net monetary salvage .			97 29
Loss			$39 80
Monetary salvage . . .		79.9%	

Sound weight of cotton . . . . . 1406 pounds.
Sound white cotton (3 bales) 561 pounds.
" " " (2 bales) 396 "
Burnt pickings (3 bales) 131 "
" " (2 bales) 75 "
1,163 "
Cotton consumed . . . . . 243 pounds.
Salvage by weight 82.73%
Sound dry cotton 68.06%

Hut No. 3.

5 LOWRY BALES, sound weight, 1246 lbs. at .07$\frac{9}{10}$ $90 95

Salvage.

Dry white cotton, 413 lbs. at .07$\frac{9}{10}$ $30.15

	Wet weight.	Dry weight.	
Choice burnt pickings,	1202 lbs.	524 lbs. at .03$\frac{3}{4}$	19 65
			$49 80

Expense.

Cost to pick	$1 89		
Cost to dry	3 93	5 82	
Net monetary salvage .			43 98
Loss			$46 97
Monetary salvage . . .		48.35%	

Sound weight of cotton . . . . . 1246 pounds.
Dry white cotton . . . . . 413 pounds.
Burnt pickings . . . . . 524 "
937 "
Cotton consumed . . . . . 309 pounds.
Salvage by weight 75.20%
Sound dry cotton 33.14%

Hut No. 4.

2 BALES RECOMPRESSED COTTON, sound weight, — 1096 lbs. at .09$\frac{9}{16}$ $104 82

Salvage.

Dry white cotton, 649 lbs. at .09$\frac{9}{16}$ $62 07

	Wet weight.	Dry weight.	
Choice burnt pickings,	385 lbs.	167 lbs. at .03$\frac{3}{4}$	6 26
			$68 33

LARGE HUT No. 5, CONTAINING EACH TYPE OF BALE BEFORE FRONT WAS REPLACED AND FIRE STARTED.

Expense.

Cost to pick	$1 47		
Cost to dry	1 25	2 72	
Net monetary salvage			65 61
Loss			$39 21
Monetary salvage		62.59%	

Sound weight of cotton . . . . . 1096 pounds.
Dry white cotton . . . . . 649 pounds.
Burnt pickings . . . . . 167 " 816

Cotton consumed . . . . . 280 pounds.
Salvage by weight 74.46%
Sound dry cotton 59.22%

Hut No. 5.

1 BALE RECOMPRESSED COTTON, 577 lbs. at .09 9/16 . . . $55 17

Salvage.

Dry white cotton, 373 lbs. at .09 9/16		$35 68	
	Wet weight. Dry weight.		
Choice burnt pickings, 145 lbs.	80 lbs. at .03 3/4	3 00	
		$38 68	

Expense.

Cost to pick	$0 58		
Cost to dry	0 60	1 18	
Net monetary salvage			37 50
Loss			$17 67
Monetary salvage		67.96%	

Hut No. 5.

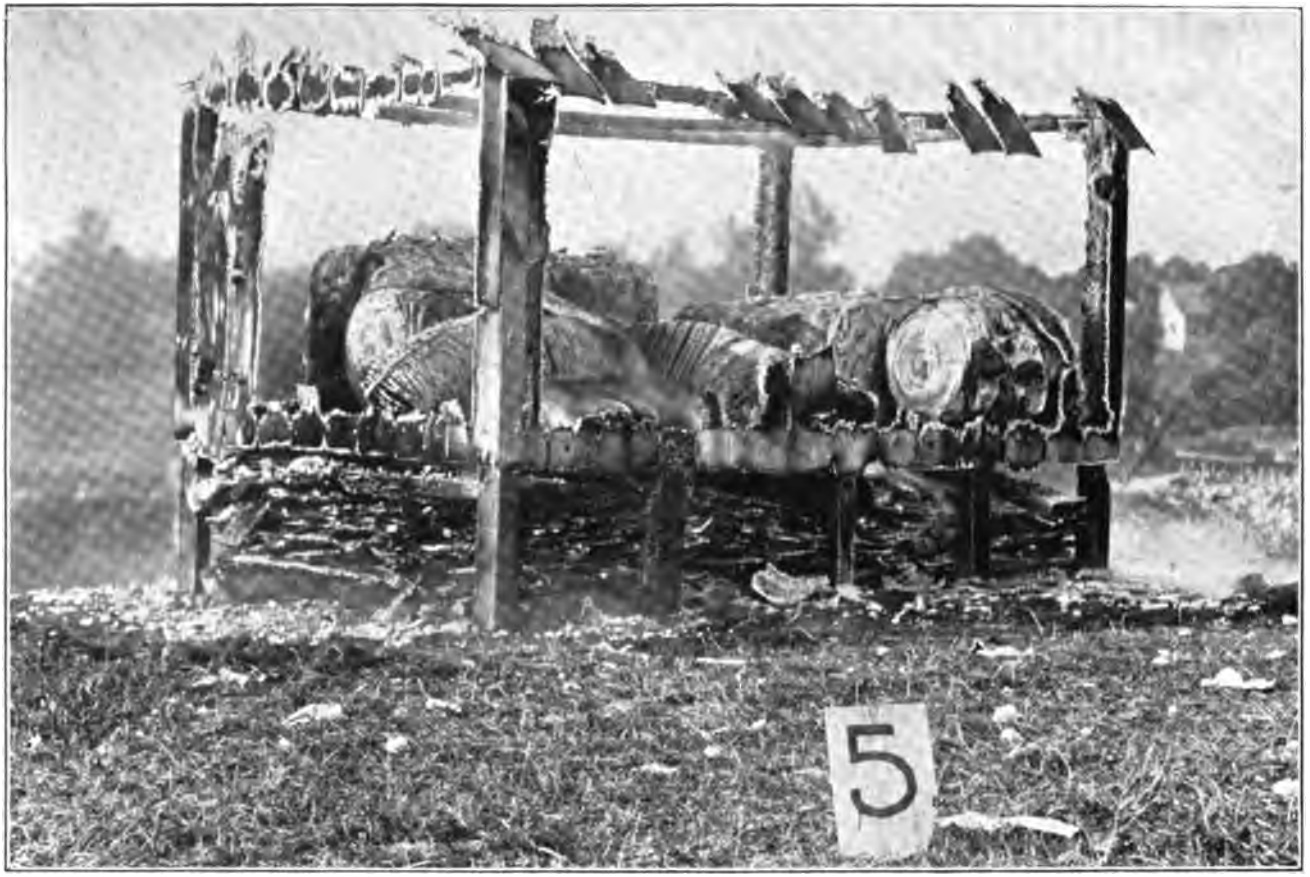
1 GIN BALE COTTON, 342 lbs. at .09 9/16 . . . . . $32 71

Salvage.

Dry white cotton, 138 lbs. at .09 9/16		$13 20	
	Wet weight. Dry weight.		
Choice burnt pickings, 125 lbs.	63 lbs. at .03 3/4	2 37	
		$15 57	

Expense.

Cost to pick	$0 44		
Cost to dry	48	92	
Net monetary salvage			14 65
Loss			$18 06
Monetary salvage		44.78%	



LARGE HUT AFTER BURNING TWENTY MINUTES.

Hut No. 5.

2 AMERICAN BALES, 549 lbs. at .09¾			$53 54
Salvage.			
Dry white cotton, 384 lbs. at .09¾		$37 44	
	Wet weight. Dry weight.		
Choice burnt pickings, 147 lbs.	72 lbs. at .03¾	2 70	
		$40 14	
Expense.			
Cost to pick	$0 93		
Cost to dry	54	1 47	
	Net monetary salvage		38 67
	Loss		$14 87
	Monetary salvage	72.22%	

Hut No. 5.

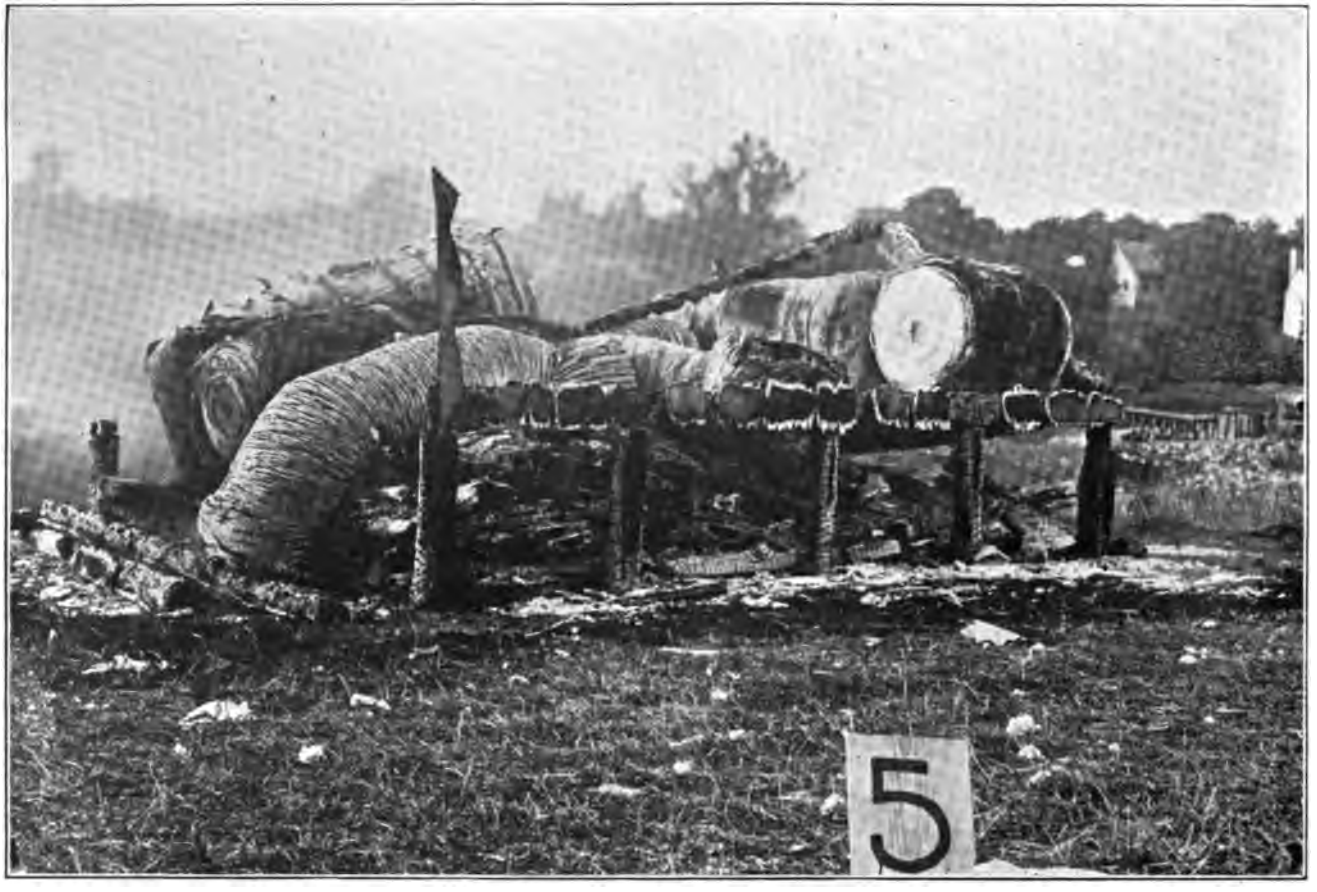
2 LOWRY BALES, 514 lbs. at .07 9/10			$37 52
Salvage.			
Dry white cotton, 182 lbs. at .7 9/10		$13 29	
	Wet weight. Dry weight.		
Choice burnt pickings, 493 lbs.	214 lbs. at .03¾	8 03	
		$21 32	
Expense.			
Cost to pick	$0 88		
Cost to dry	1 60	2 48	
	Net monetary salvage		18 84
	Loss		$18 68
	Monetary salvage	50.2%	

Hut No. 5.

1 BALE DRY GOODS.
Weight after drying, 186 lbs.
Expense.
Cost to dry $1 30

ACCOUNT OF ROUND BALES SUBMERGED.

1 AMERICAN ROUND BALE, 270 lbs., at .09¾			$26 33
Salvage.			
Dry white cotton, 188 lbs., at .09¾		$18 33	
	Wet weight. Dry weight.		
Pickings, 144 lbs.	75 lbs. at .05	3 75	
		$22 08	



LARGE HUT AFTER BURNING FORTY MINUTES.

Expense.

Cost to pick	$0 40		
Cost to dry	57		
		97	
	Net monetary salvage .		21 11
	Loss		$5 22
	Monetary salvage, 80.17%		
1 LOWRY BALE, 260 lbs., at .07 3/10			$18 98
Salvage.			
Dry white cotton, 197 lbs., at .07 3/10		$14 38	
Wet weight. Dry weight.			
Pickings, 94 lbs. 62 lbs. at .05		3 10	
		$17 48	

Expense.

Cost to pick	$0 45		
Cost to dry	48		
		93	
	Net salvage		16 55
	Loss		$2 43
	Monetary salvage, 87.19%		

ACCOUNT OF RECOMPRESSED BALE SUBMERGED.

Before . . . . . 560 pounds.
After taking out . . . . . 1,468 "
Entirely saturated.

ACCOUNT OF GIN BALES SUBMERGED.

Before . . . . . 507 pounds.
After taking out . . . . . 1,558 "
Entirely saturated.

RESUME, CONCLUSIONS AND SUGGESTIONS.

Your Committee is pleased to state that the various participants express themselves to the effect that the tests have been conducted in an eminently fair and impartial manner.

Our observations warrant grading the subjects of investigation in the following relative positions:

LARGE HUT AFTER BURNING ONE HOUR.

ORDER OF EXCELLENCE.

Test.	American.	Lowry.	Dry Goods.	Recompressed.	Gin.
Flash	1	2	3	4	5
Burrowing . .	2	1	.	3	4
Fire	1	4	5	2	3
Immersion . .	2	1	.	3	4

FLASH TEST.

One result stands out clearly above all others as of prime importance to fire underwriters. It is shown that *the American and Lowry bales are not subject to flash fires.* In this test the fire flashed immediately over the square bales, but did not spread at all on the cylindrical bales.

There seems to be but little gained by using the special covering treated with the fire retardant.

Baled dry goods that are not completely covered with burlap are more easily set on fire than American or Lowry baled cotton.

Statistics based upon the ordinary square bale while on storage and in shipment show a large majority of cotton fires to be caused from sparks, matches, and smouldering tobacco igniting the loose cotton found exposed and protruding from the square bale. These tests show that with the cylindrical (American and Lowry) bales such fires would be largely eliminated.

Experience with cotton fires shows that flames flash with incredible rapidity over the exterior surface of adjoining ordinary square bales. The almost instantaneous spread of such fires has frequently resulted in loss of life as well as of property, and extended the flames beyond available means of extinguishment. The cylindrical bales also eliminate this most undesirable feature. Therefore, their introduction in lieu of the present commercial square bale could be confidently expected to largely reduce the number of fires, and, where fire did occur, to occasion a less rapid spread of flames, a slower combustion, and hence much greater chance of extinguishment and salvage.

This superiority is due to the use of a closely woven and snug fitting burlap covering on the cylindrical bales. This covering and the cotton on the outer surface of the bale do not burn freely in the early stages

LARGE HUT. FLAMES HAVING BEEN EXTINGUISHED BY HOSE STREAM AFTER BURNING ONE HOUR.

of a fire, as, due to the close fit, there is a limited amount of air, necessary to support combustion, admitted between the two. On the other hand, the ordinary square bale with its open mesh jute bagging allows the less closely compressed cotton to protrude through the meshes, thus inviting fire.

As between American and Lowry bales, the latter is more exposed to sparks because of the open end, and, once ignited, burns somewhat more freely in the first stages of a fire, due to the covering not being as closely applied to the cotton.

The large size and weight of the square bale neccessitates the free use of hooks and tackle in shipping, and, furthermore, it is "screwed in" and "broken out" of ships' holds, which, aside from sampling, subjects the bagging to rough usage with the inevitable result that it becomes torn in several places on the average bale, thus allowing the cotton to be exposed in large patches, sometimes comprising the entire side or end of a bale.

Due to its small weight and form, making it easy to roll about, the cylindrical bale suffers little in transit, and even the burlap covering remains substantially intact, not of necessity being subject to the use of hooks. Again, if the covering becomes torn, due to its close adhesion, to the cotton and the greater density of the latter, there is little inclination for the cotton to protrude through the rent.

Sampling of the ordinary square bale is generally practised and results in exposing the cotton to a greater than normal extent at one or more points. The American bale can be sampled by ripping the stitches of the covering at one of the seams; the Lowry bale at either end of the bag.

The square bales can be piled more closely together than the cylindrical, which is a point in favor of the former. It would seem to us desirable to suggest that the Lowry bale be entirely covered with burlap, and that the square bale interests might to advantage consider the advisability and feasibility of putting up cotton in a smaller bale much more easily handled without injury to the covering, and then using a closely woven burlap covering, so compressing the bale, applying the cover and the ties that the latter will not tear the burlap and that the burlap will lie closely against the cotton at all sides of the bale.*

* That is the point which was specially emphasized by the speaker at the meeting in New York. W. D. HARTSHORNE.

HUT IN WHICH BURROWING TEST WAS CONDUCTED.

Much judgment must be exercised in making deductions from this particular test and applying them to cotton fire hazards. The conditions of test are not likely to be the same as those found in practice, the latter varying from slight scorching to complete combustion. In this test the cotton was placed upon a grid and broiled, as it were over a wood fire for one hour. At a platform, pier, or warehouse, at least a portion of the cotton is to be found resting on a solid floor. Many fires will be found much less severe, while on the other hand, others are of greater intensity and longer duration. It can be seen from the tests that, had the fire not brought about a high enough temperature or continued long enough to cause the bursting of the bands on the Lowry bales, the salvage results for this bale would have been altogether better. Had the fire continued for a longer period and attained sufficient heat to cause the bursting of the ties on the recompressed and gin bales as occurs occasionally in actual warehouse fires, the salvage results would have been less satisfactory on these two types of bale. Ties are used on a bale to restrain compressed cotton, and, when they break, the cotton naturally opens up and is thus much more susceptible to quick burning. In this connection, it is noted that the American bale has no ties and is self-contained, due to the adhesion of the cotton fibres forming the continuous lap, which because of the method of conpression, contains no force to expand the bale.

The Lowry bale is noticeable in this test as rendering comparatively small salvage after a severe fire, due to expansion of the bale, bursting of ties, and opening up of the cotton to the flames throughout the entire length of the bale. This is occassioned by the method of forming the bale, whereby we would liken the cotton restrained by the ties to a spiral spring held under compression.

This action has been noted in other fires which reached a severe heat.

It has been suggested that this expansion might be the means of injuring walls or floors in event of fire in a closely packed wareroom containing this type of bale.

To the proprietors is suggested the consideration of some means of overcoming this defect.

Particular attention is called to the nearly total damage to the bale of dry goods by the flames flashing over one side and scorching the edge of each fold of cloth. This ruin was completed during the first

TABLE OF SALVAGE RESULTS FROM FIRE TEST

HUT NO.	TYPE OF BALE	ORIG. WT. LBS.	SOUND VALUE $	UNDAMAGED COTTON			DAMAGED COTTON				DESTROYED BY COMBUSTION		SALVAGE EXPENSE	WATER ABSORBED IN EXTINGUISHING		TOTAL SALVAGE			
				WEIGHT LBS	VALUE $	W. ORV. %	WEIGHT, DRY LBS	%	VALUE $	%	LBS	%	$	LBS	%	WEIGHT LBS	WEIGHT %	NET VALUE $	NET VALUE %
5	AM.	549	53.54	384	37.44	69.84	72	13.11	2.70	5.04	93	16.94	1.47	75	13.66	456	83.06	38.67	72.22
2	AM.	1406	137.09	957	93.31	68.06	206	14.65	7.72	5.63	243	17.28	3.74	214	15.22	1163	82.71	97.29	70.96
5	RE-COMP.	577	55.17	373	35.68	64.64	80	13.86	3.00	5.43	124	21.49	1.18	65	11.26	453	78.50	37.50	67.96
4	RE-COMP.	1096	104.82	649	62.07	59.21	167	15.23	6.26	5.97	280	25.54	2.72	218	19.89	816	74.45	65.61	62.59
1	GIN	933	89.22	470	44.95	50.38	152	16.29	5.70	6.39	311	33.33	2.17	209	22.40	622	66.66	48.48	54.33
5	LOWRY	514	37.52	182	13.29	35.40	214	41.63	8.03	21.40	118	22.95	2.48	279	54.28	396	77.04	18.84	50.21
3	LOWRY	1246	90.95	413	30.15	33.15	524	42.05	19.65	21.60	309	24.80	5.82	678	54.41	937	75.20	48.98	48.35
5	GIN	342	32.71	138	13.20	40.35	63	18.42	2.37	7.24	141	41.23	.92	62	18.12	201	58.77	14.65	44.78
5	DRY GOODS	290		0	0		186	64.13			104	35.86	1.30						

few minutes of the fire test. Yet no appreciable monetary damage was done any of the cotton bales by the flash test. Therefore, with the flash hazard removed, as with the cylindrical bales, the cotton presents a better "fire risk" than the dry goods in bales.

The wire ties on one of the gin bales demonstrated weakness as against the strap ties on a similar bale.

We offer as a part of our summary the following table, showing concisely the salvage results, and call special attention to the columns which show percentages of salvage to original sound weight and value.

Burrowing Test.

It has been commonly observed that fires are inclined to eat their way into the interior of the ordinary square bale, pursuing irregular courses as determined by paths of least resistance. These tests were not extensive enough to determine the comparative susceptibility of the several types to burrowing fires, as the fire in each case, although slow, spread much more rapidly on the outside of the bales. However, it developed that, due to greater density, the cylindrical bales would in numerous instances resist ignition aud not support a fire as from sparks or brands, while the square bale in each case was destroyed upon the first test. The Lowry bale successfully resisted repeated applications of a hot bolt head to the *side* of the bale, but was destroyed upon application at the *end*. Precisely the reverse was true with the American bale, which was easily fired from the *side* but with difficulty from the *end*. It may be concluded, therefore, that so far as this single feature is concerned, it would be well to store American bales on end, Lowry bales on side. This red hot bolt head constitutes a much more severe trial than that ordinarily furnished by sparks and cigar butts.

These tests, as they developed, serve rather to supplement the flash and burning tests than to bring out facts relating to fire eating its way through or burning out the interior of bales.

We are not able with the information at hand, to pass upon the claims frequently made for cylindrical bales, that, due to the extreme pressure and mechanical means employed in putting up the bale, there is no possibility of sparks, unignited matches, etc., being compressed within the bale, as has been done when recompressing the square bale, or in other words, putting up a bale with fire buried within, which in time, perhaps many days afterwadrs, may burrow outward and be the means of a more serious conflagration. It is, however, self evident from the

TABLE OF SALVAGE RESULT FROM IMMERSION TEST

TYPE OF BALE	ORIG'L WT LBS	SOUND VALUE $	DRY COTTON			WET COTTON			LOST COTTON		SALVAGE EXPENSE $	WATER ABSORBED		TOTAL SALVAGE			
			WEIGHT LBS	VALUE $	W OR V %	WEIGHT LBS	WEIGHT %	VALUE $	LBS	%		LBS	%	WEIGHT LBS	WEIGHT %	NET VALUE $	NET VALUE %
AM.	270	26.33	188	18.33	69.63	75	27.77	3.75	7	2.59	.97	69	25.55	263	97.40	21.11	80.17
LOWRY	260	18.98	197	14.38	75.77	62	23.84	3.10	1	.38	.93	32	12.30	259	99.61	16.55	87.19
RE-COMP.	ENTIRELY SATURATED																
GIN	ENTIRELY SATURATED																

methods of preparing these cylindrical bales that there is less likelihood of foreign matters, particulary of any size, being put up in the bale, and that the considerable exclusion of air accomplished in the process would have a tendency to smother combustion in the interior of such bales.

IMMERSION TESTS.

Results in this test are derived from holding the bales entirely submerged beneath the surface of water, as frequently occurs in practice, but yet are not the same as when the bales are thrown overboard and allowed to float, when they are only partially submerged and a much longer time would be required for them to become sufficiently saturated to sink. On the other hand, had the submersion been continued longer, the expansion might have been sufficient to burst the ties.

The following conditions obtained immediately upon the removal of cotton from the vats:

48-HOUR IMMERSION TEST.

Type.	Dry Weight.	Wet Weight.	Water Absorbed.
Lowry	260 Pounds.	312 Pounds.	20 Per Cent.
American	270 "	366 "	35 "
Recompressed	560 "	1468+ "	162+ "
Gin	507 "	1558+ "	207+ "

Results noted in table on next page were ascertained after removal to establishment of J. Wallworth & Sons.

SUMMARY.

In final summarization, your Committee would report that it finds the cylindrical bales to be distinctly superior to the square bales as fire risks, and, in turn, the American bale snperior to the Lowry, the recompressed to the gin bale, and both cylindrical bales to the dry goods.

The PRESIDENT. As this concludes the programme for the afternoon, I declare the session adjourned until ten o'clock tomorrow forenoon.

THIRD SESSION.

THURSDAY MORNING, APRIL 23, 1903.

The Association met in Chipman Hall at 10 A. M., President FISH in the chair.

THE PRESIDENT. The first paper is on the important subject of Textile Education by Mr. WALTER M. HASTINGS of Lawrence, Mass.

*TEXTILE EDUCATION.

WALTER M. HASTINGS, Lawrence, Mass.

[Formerly Director Textile Department, American School of Correspondence, at Armour Institute of Technology, Chicago, Ill.]

The strides made in textile education in this country during the past few years are due not only to the large number of friends which education of this nature has gained, but also to the soundness of the principles involved. Knowledge and its application has always been a forerunner of success or even success itself, whether in individual, state, or national life; our country itself and our great corporations are a living proof of this.

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* For further references on this subject see Transactions as follows: Vol. 6, p. 5, GEO. L. WARD, Resolutions on Textile Education; Vol. 8, p. 19, Report of a Committee; Vol. 9, p. 5, Resolution on Textile Education; Vol. 35, p. 54, EDWARD ATKINSON, European Textile School; Vol. 57, p. 140, E. W. ATKINSON, Technical Textile Schools; Vol. 60, p. 187, EDWARD W. FRANCE, Textile Education; Vol. 60, p. 208, FRANK P. BENNETT, Public Textile Education; Vol. 62, p. 87, CURTIS GUILD, Jr., New England Cotton Mills; Vol. 62, p. 170, CHRISTOPHER P. BROOKS, The Lowell Textile School; Vol. 62, p. 257, ROBERT S. RANTOUL, The Beverly Cotton Mill; Vol. 63, p. 113, EDWARD W. FRANCE, Artistic Element in Technical Education; Vol. 63, p. 251, C. J. H. WOODBURY, Purpose of Textile Education; Vol. 63, p. 357, CHANNING WHITAKER, Cotton Yarn Department, Lowell Textile School; Vol. 64, p. 95, GEORGE P. GRANT, Jr., Resolutions on Textile Education; Vol. 66, p. 145, CHRISTOPHER P. BROOKS, Second-hand Machines for Textile Schools; Vol. 67, p. 142, CHRISTOPHER P. BROOKS, Textile Instruction by Mail; Vol. 69, p. 180, RICHARD H. EDMONDS, Instruction in Spinning; Vol. 71, p. 94, WILLIAM FIRTH, Purchase of a Scholarship in a Textile School; Vol. 72, p. 131, W. W. CROSBY, Methods of Textile Instruction; Vol. 73, p. 369, ARNOLD B. SANFORD, Textile Education.

The fine resident textile schools already in operation have proved of great value to the textile trade, as instanced by the fact that the demand for technically educated textile men is greater than the supply; and although doing a wonderful work today, will be a far greater power in the textile trade ten years from now.

The men who derive the benefit from them may, generally speaking, be divided into two bodies: The class of students attending the day school is largely composed of men who have the time and money to devote themselves exclusively to their studies, and those attending the night school who, on the other hand, consist almost entirely of men who work in the mills. Thus the question, "Does the resident textile school turn out superintendents, or does it render mill workers more efficient?" may be in part answered after careful observation. The schools will undoubtedly turn out superintendents, and also a more efficient class of overseers, together with young men somewhat above the ordinary level of what is known as mill help, and who will eventually become overseers.

The former class of men are drawn from all over the country to the various cities in which the resident schools are located; that, of course, is a foregone conclusion, inasmuch as they have the time and money to pursue whatever educational advantages are offered. The second class, those who work in the mills, is necessarily local. Figuratively speaking, they are drawn from a radius of a dozen miles of the resident school home. And inasmuch as these two classes of men have the advantage of fine laboratories and good instruction, they are well taken care of from an educational standpoint. These men enjoy exceptional advantages, greater, probably, than they realize. The means to success have been actually placed within their reach, to grasp or brush aside. They are, in fact, eminently in the position to make or mar themselves. It is not of these men of whom I would speak; their continued assistance is assured; but of those outside the charmed circle; what of them? Is there no way of giving them assistance?

The number of day students attending resident schools is limited, as young men throughout the country incline toward the various branches of engineering and also by the lack of money by the individual to devote to educational pursuits. The number of night students is restricted, also, by the inclination of the men themselves, but primarily by distance between mill and school. It can thus be seen that an enormous body of men coming under the head of the night student class is barred from a technical education simply by the fact that they are not within reach of the resident textile school.

Thus the large majority of men who would, if conditions permitted, obtain a textile school education, are not, as the papers would say, "covered". They have not the advantages of these schools, and in remote districts they are undoubtedly curtailed in the ordinary education. It is, of course, impossible for them to obtain positions in or near cities which contain textile schools, and the thought is consequently hardly worth considering. It is a fact, on the other hand, that where state aid is given to textile schools, these same men add their mite to the support of the schools without receiving the benefits. As a class they are bound hand and foot to the section of the country in which their work is located. The struggle for existence does not encourage any movement on their part. Their growth must of necessity be slower than that of their more fortunate brethren. Technical education which would mean much to them would also mean much to their employers, as is proven by the steadily increasing demand for technically educated men. Those in their ranks who have risen, and this is applicable to nine-tenths of the successful mill men of today, have done so by sheer bodily strength and perseverence. They have worked not only early and late in the mills, but have toiled far into the night year in and year out to become what they are.

And in this struggle the textile trade has undoubtedly lost many bright minds of men who were physically unable to stand the tremendous strain; men who would have been a credit and probably an important factor in the development of the industry.

a comb, F, which is carried by several arms, G. These arms are fastened to the comb shaft, H, which is hung from the shaft, P, by swing stands, M. The oscillations of the comb are obtained from a pulley, J, in one arm of which is fastened a stud, T. This stud is connected by a pitman, K, to a similar stud, V, in the arm, L, which is fastened to the comb shaft.

Fig. 29 shows an enlarged section of a part of the feeder and Fig. 30 an elevation of the same.

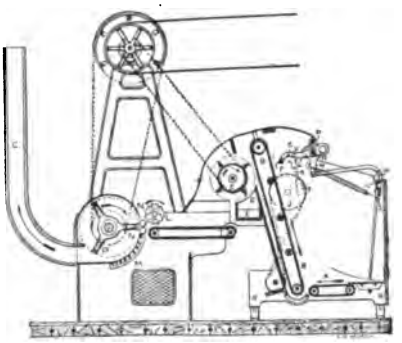


Fig. 28. Automatic Feeder with Evener Attached.

The device for regulating the feed is constructed in the following manner: In the back part of the hopper is a rack, R, constructed similarly to a rake, with very long tines, which is suspended from each side of the hopper by studs, U, which form a center about which it swings. Projecting from the top of the rack are stands, W, connected to the comb-shaft swing stands by arms, N. By this arrangement, any swinging motion of the rack will be com-

FIGURE 1.

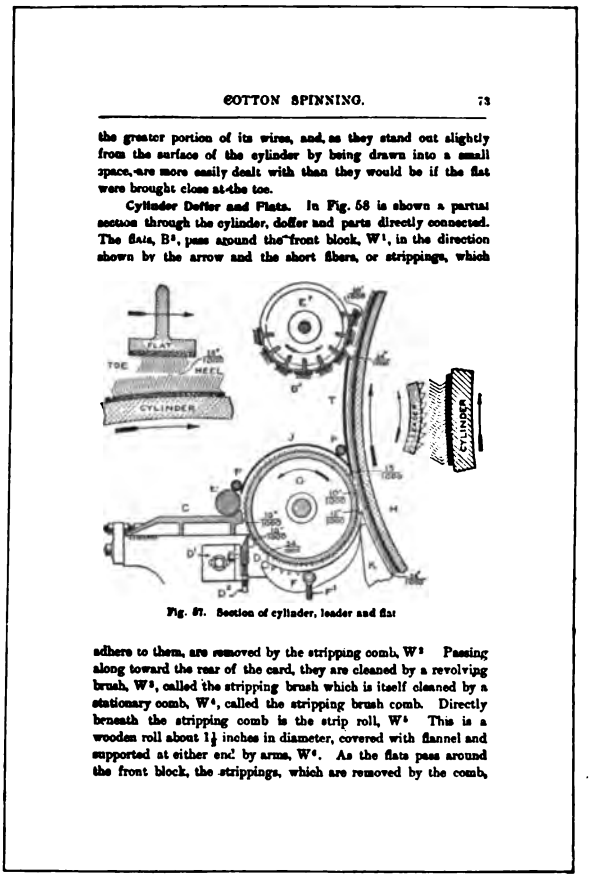
Specimen Page taken from an Instruction Paper on Picking.
(Reduced size.)

The men who confront the same conditions in our country today should be helped over the hard places and there is a way by which they may be benefitted; they cannot go to the textile school, consequently the textile school should be made to go to them; and the only way in which this may be done is by the correspondence system.

There are various precedents for this system, many of which are undoubtedly good. The Chicago University is an example of this; the great university in New Haven, Yale, is another striking example. The Armour Institute at Chicago also has its system. All of these colleges have been successful in spreading knowledge both technical and classical, and inasmuch as textile engineering is a branch of the former, there is no doubt but what by proper methods and management wonderful strides in this can be accomplished.

It has been found that books of instruction for a work of this nature must be especially prepared. They must be intensely practical and minute in their dealings with the subject. In other words, the instructor must live in each book. It goes without saying that those who prepare books for correspondence instruction should be men of known ability in the subject on which they write. This is as true of the correspondence school as of the college, although it may not always have been taken into account in the past. The foundation for a course, for instance, on cotton spinning, should be exhaustive and complete, and inasmuch as many of the textile workers in this country have had few educational advantages, the preliminary studies should begin at the lowest step and lead the student gradually from that point to the place where he may be said to have received a *good* foundation.

The student begins with simple arithmetic and takes up elementary algebra. Mechanism, mechanics, mechanical drawing and machine design are extremely valuable and important subjects. These follow the simpler ones. When they are mastered the conscientious student is well prepared to understand the theoretical part of cotton spinning and weaving. It is advisable and generally assumed where the school is founded upon advanced lines, that the student be employed in some branch of the trade to which his studies apply, in order that he may get a practical as well as a theoretical training. It is particularly true of small mills that there is generally no objection to his seeing



COTTON SPINNING. 73

the greater portion of its wires, and, as they stand out slightly from the surface of the cylinder by being drawn into a small space, are more easily dealt with than they would be if the flat were brought close at the toe.

Cylinder Doffer and Flats. In Fig. 58 is shown a partial section through the cylinder, doffer and parts directly connected. The flats, B^2, pass around the front block, W^1, in the direction shown by the arrow and the short fibers, or strippings, which

Fig. 57. Section of cylinder, leader and flat

adhere to them, are removed by the stripping comb, W^3. Passing along toward the rear of the card, they are cleaned by a revolving brush, W^5, called the stripping brush which is itself cleaned by a stationary comb, W^6, called the stripping brush comb. Directly beneath the stripping comb is the strip roll, W^4. This is a wooden roll about $1\frac{1}{2}$ inches in diameter, covered with flannel and supported at either end by arms, W^6. As the flats pass around the front block, the strippings, which are removed by the comb,

FIGURE 2.

Specimen Page on Cotton Carding.
(Reduced size.)

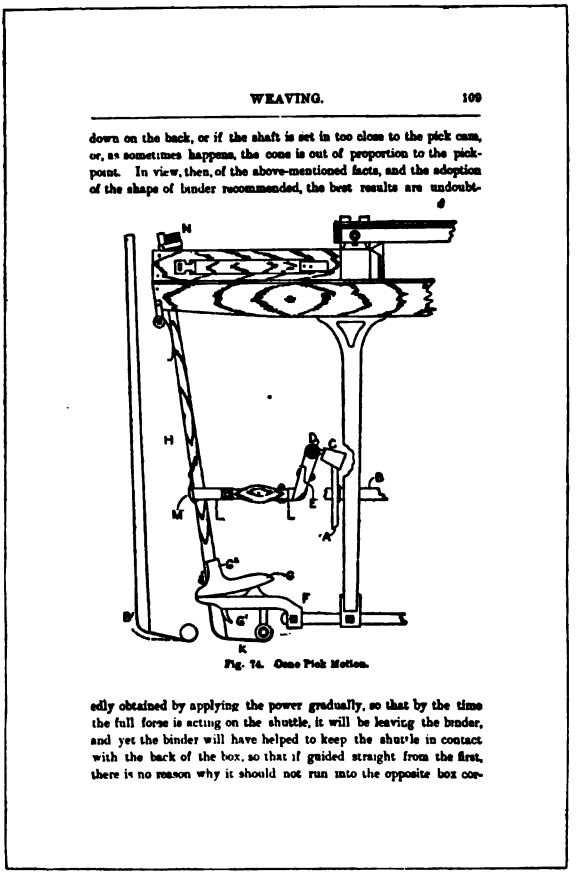
and examining in off hours machinery with which he does not frequently come in contact.

The instruction books on cotton spinning are of various lengths, according to the branches under consideration, eighty pages being an average size. After completing each instruction paper the student is examined, not as in colleges where it is

assumed that if a few questions are correctly answered the pupil undoubtedly understands the whole, but exhaustively, in order that but few points be missed. The instruction progresses along the familiar lines, starting with cotton fibre, then picking, carding, combing, after which comes drawing, slubbers and fly frames, ring spinning and mule spinning completing this section of the work; warp preparation, the plain power loom, box looms, dobby and jacquard work, together with possibly designing, complete the instruction proper. If the student is a bright man and ambitious, he may also elect to do some theoretical work in steam or electrical engineering, preferably the latter if connected with a southern mill.

The work of giving a fair education by this method is not as great as it might at first appear. The student generally has a good or moderately practical knowledge of the subject in which he is studying. The fact that he is studying his chosen line proves that he is interested, which is a strong point in his favor. He probably knows the functions which a card or picker performs, but possibly is familiar with little else on the subject. He undoubtedly knows that in most mills in which he has worked the machinery was arranged in a certain manner. On the other hand, he probably does not know the reason and the peculiar adaptability for that arrangement.

The student when taking some correspondence systems is examined orally at the end of a certain period by some professor in his vicinity. In textile work this would hardly be practical, consequently he is placed upon his honor to do right. The manufacturer at this point may ask a very pertinent question. "What is to prevent the correspondence student from copying his answers to examinations direct from his instruction papers?" The answer is this:—"He is interested in his own advancement, otherwise he would not have taken the course." It is true, unfortunately, that a small number of men in every hundred are dishonest in the matter of examinations, both in correspondence systems and among the men of resident colleges. Some men are bound to obtain high percentages with the minimum of



WEAVING. 109

down on the back, or if the shaft is set in too close to the pick cam, or, as sometimes happens, the cone is out of proportion to the pick-point. In view, then, of the above-mentioned facts, and the adoption of the shape of binder recommended, the best results are undoubt-

Fig. 74. Cone Pick Motion.

edly obtained by applying the power gradually, so that by the time the full force is acting on the shuttle, it will be leaving the binder, and yet the binder will have helped to keep the shuttle in contact with the back of the box, so that if guided straight from the first, there is no reason why it should not run into the opposite box cor-

FIGURE 3.

Page from an Instruction Paper on Weaving.
(Reduced size.)

necessary work. They can be found in equal numbers in the best organized modern colleges and probably in correspondence schools. This subterfuge avails them little, however, as they are left behind in the struggle for existence.

The point to be discussed is this: Here is a method by which a man even in a discouraging environment, from an

educational point of view, can by hard work and study, obtain a certain amount of education. He can make it a part of himself and apply it to his profession or trade. This has been proven hundreds of times where the correspondence student by diligence has saved one or two years at a college, by having equipped himself in certain subjects through a system of this kind. If this can be accomplished in classical and other technical branches, it can undoubtedly be accomplished in textile work.

The modern resident textile school if equipped with a thorough correspondence course on the various branches of textile work, would, without doubt, instruct many hundreds of men who have found it impossible to obtain knowledge in any other way. Men of fair practical training in textiles who had but a year to give to resident work could be equipped and instructed in the methods of a resident school, and instead of doing preliminary work, could be admitted to start at once on advanced studies; in fact, a polishing off and rounding out of their education.

We belong to a rapidly progressing country and the ratio of increase should be greater each succeeding year. Methods far in advance of the ordinary must be practiced to keep well ahead. We have fine textile schools which are of great advantage to a large number of textile men, but inasmuch as there is a larger number whom we cannot instruct by our present methods, but to whom we should allow advantages, this subject is worthy of serious consideration, and the result will not only be to the advantage of the employes but also to the mill owners themselves.

The SECRETARY. Now in contra-distinction to this paper is one on An English Textile School, by Mr. T. M. YOUNG, of the Manchester Guardian, whom many of you remember as having been with the English delegation who were our guests here a year ago. Mr. YOUNG has made a very interesting book on the American Cotton Industry, and I wrote him a note stating that I had read it with a very great deal of interest and could only account for the omission of any reference to his visit here to the fact that he was holding this in reserve for a special paper for this meeting of the Association, and the paper came forth. (Paper read by the Secretary in the absence of the author.)

AN ENGLISH TEXTILE SCHOOL.

T. M. YOUNG, of The "*Manchester Guardian*", Author of "*The American Cotton Industry*", Manchester, England.

When your Secretary honored me with an invitation to write a paper for this meeting of your Association, my first impulse was to decline with thanks, on two grounds, to wit: the engagements of a busy life, and the inability of a mere Englishman to tell Americans anything that they do not know already. But when I considered that you had made me your guest at your annual meeting in April, 1902, and that many of your members, in spite of engagements as pressing as mine, had freely spent time and trouble in helping me to study the conditions of the American Cotton Industry, I felt that it would be churlish in me not to do what he asked. And, as I know that nothing interests Americans more than very new things (except, perhaps, very old things), I have chosen as my subject the newest and largest English school in which students are trained for the various branches of the cotton industry.

The building, some pictures of which accompany my paper, covers an area of 8,548 square yards, and over the greater part of the site there are six or seven stories above the street level and two below it. The work of building and equipment took seven years, and was finished but a few months ago. The value

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* For further references on this subject, see citations to Transactions in foot note under paper on Textile Education by WALTER MAXWELL HASTINGS on page 326.

of the completed school with its site is one and a half million dollars, part of which was given by the legatees of the late Sir JOSEPH WHITWORTH (the great engineer), whilst the rest has been furnished by the city of Manchester, to which the school (as well as the School of Art and the Arts and Crafts Museum which are affiliated with it) belongs. Having regard to the additional means of scientific education afforded by the University of Manchester, the city is probably better equipped for the teaching of engineering, applied chemistry, and textile technology than any other in the United Kingdom.

The ideal conception of technological education carries us far beyond the old-fashioned notion of a technical school. In 1900 a committee of the American Society for the Promotion of Engineering Education reported that most of the "so-called technical schools" of England were designed to serve young men otherwise employed throughout the day. "The student," says the report, "Comes two or three evenings a week from seven or eight to ten o'clock. He comes more or less worn out by his day's toil, and he reaches home long after his usual retiring hour, practically exhausted. His mind cannot be alert with his body in a fagged-out condition, and hence this class of instruction is at once a great hardship and in comparison with day schools is of relatively little profit. Men who are engaged in any kind of actual manual labor through the day are greatly handicapped in their attendance upon such schools. They are most valuable for clerks, bookkeepers, draughtsmen, and the like. They can never become a very substantial element in the technical education of the industrial classes."

This criticism of English technical schools as they have hitherto been known is endorsed by Professor ALDERSON, Dean of the Armour Institute at Chicago. Although, on the whole, a just, it is hardly an exhaustive criticism, for in spite of their serious defects the English technical schools — and among them the Manchester Technical School — have done a substantial amount of really useful work. But only the extraordinary aptitude and dogged industry which are characteristic of the people

of the North of England have enabled so much good work to be accomplished by the evening classes. Lads working laboriously from 6 A. M. to 5.30 P. M. have spent two hours at school in the evening and two hours more at their home work, and have kept this up for years, achieving in the end thorough and solid proficiency — but at what a cost? And their efforts have undoubtedly been hampered by their defective elementary education and by their association in the classes with a large proportion of casual students who have gone to the school for limited instruction in one or two subjects or who have been sent there against their will because their parents supposed them to have a mechanical bent.

The English technical school has suffered much also from the attitude of the middle classes, which have been too much in the habit of regarding it as a place in which the "industrious apprentice" might profitably spend his evenings so as to fit himself some day to be a foreman or to hold some even higher position amongst the non-commissioned officers of industry — as a place, even, where the son of his employer, destined to succeed to the supreme command, might potter about more or less aimlessly among machines and text books in order to gain in the least laborious way some smattering of the practice and theory of his future business, or again as the natural destination of all such lads as, too dull-witted or indolent for a learned profession, had been observed to be fond of looking at locomotives or playing at carpentry or any other of the idle occupations which fond parents recognize at once as the signs of latent mechanical genius.

Enough has been said to indicate the difference between the modern school of technology such as has been evolved in America and Germany and the old-fashioned English technical school. The one is a school for training professional experts — educated men capable shortly after leaving the school of filling positions of responsibility and emolument; in a word, professional directors of industrial enterprise; the other is a school which, whatever its aims, has in the main succeeded only in helping its students to rise in or from the industrial ranks more easily than

they could have risen without its aid. Schools of both kinds, but sharply differentiated, exist on the Continent and, I believe, in America also; but inasmuch as the trend of modern industry is to make greater demands upon the technical knowledge of the manager or master and less upon that of the man, who tends to become more and more a machine-minder, the superior importance of the higher technological education is being increasingly recognized. The new Manchester School of Technology is an attempt to supply this kind of education. At the same time it provides the best possible accommodation and teaching for that larger class of students which desires the less intellectual kind of technical proficiency.

It may be said, broadly, that the "trade-school" instruction at the Manchester School of Technology is given in evening classes, whilst the systematic courses of technological education are taken by day students. But this broad statement needs qualification, for there is during the day-time a general preparatory course in mathematics, English, German, science, drawing, and manual training, intended to supplement defects in the preliminary education of otherwise promising candidates for technical instruction, also manual training classes for schoolmasters, and dressmaking, tailoring, millinery, needlework, and embroidery classes for women. There are, moreover, for evening students complete courses in mechanical engineering, electrical engineering, sanitary engineering, the building trades, the chemical industries, textile manufacture, and photography and printing — courses which extend over five or three years, according as the subject demands a high degree of theoretical and scientific proficiency or merely handicraft skill combined with an accurate knowledge of a few leading general principles. The five years' evening courses, satisfactorily pursued, entitle the student to the diploma of the school with the title of associate, whilst the three years' evening courses lead to a certificate of competency in the particular branch of study undertaken. The courses are intended to prepare the student for "a position of intelligent responsibility in industrial affairs and enable

him to develop on sound lines the manufacturing business in which he may be engaged." The institution of diploma courses for evening students has doubtless been forced upon the school authorities by existing local conditions, which make it difficult to attract day students.

There is in Lancashire a strongly marked impatience to enter some kind of business or trade at the age of 16 or 17, or even less, and this not only amongst the sons of parents who really need their help, but also amongst the sons of the well-to-do. Nearly all itch at about that age to be emancipated from school and to be working for their own living — to be "doing something," as the phrase is. The value of higher education in industrial work has not yet been practically grasped by the mass of Englishmen, and middle class parents in comfortable circumstances who are satisfied that their sons should work in a machine shop or office all day and pick up such additional education as they can by attending evening classes are really in a position very closely analogous to that of working men who resist the raising of the school age in public elementary schools and cause their children to seek early employment as half-timers. The evening courses, even those leading to the diploma, are unavoidably less liberal in their scope than the day courses in the corresponding subjects of study. It is not my present purpose to go with any degree of minuteness into the evening work of the school.

It is only by the education of day students — those who are able to give their whole time and strength for a number of years to the serious study of technological subjects — that the Manchester school can hope to gain a more than local fame, to make good its claim to be ranked with the great technological schools of Charlottenburg, Zurich, and Boston, and to do for Englishmen and British industry what these and other institutions are already doing for the youth and industries of their respective countries. The Manchester school offers today students eleven systematised courses of education, each of three years' duration, as compared with thirteen courses offered by the Massachu-

setts Institute of Technology at Boston, which may be taken as a model school of the kind. The Boston courses are of four years' duration, but the sessions are shorter than at Manchester. For the purposes of comparison I give the courses offered by the two schools side by side:

MANCHESTER. (Three-year Courses.)	BOSTON. (Four-year Courses.)
Mechanical engineering.	Mechanical engineering.
Electrical engineering.	Electrical engineering.
Sanitary engineering.	Sanitary engineering.
General technical chemistry.	Chemistry.
Metallurgy.	Physics.
Architecture.	Mining engineering and metallurgy.
Manufacture of textiles.	Architecture.
Bleaching, dyeing, printing, and finishing (textiles).	Civil engineering.
	Chemical engineering.
Manufacture of paper.	Naval architecture.
Brewing.	Geology.
Photography and printing.	Biology.
	General studies.

It will be noticed that in six of the subjects courses are offered at both schools, the course in metallurgy at Manchester being designed to some extent to meet the needs of mining engineers. Then comes a wide divergence. There are no day courses at the Manchester School corresponding to the Boston courses in civil engineering, physics, naval architecture, geology, biology, and general studies, the last of which combines a thorough general scientific training with a wide range of philosophic studies. Nor is there any complete course, as at Boston, in chemical engineering, although chemical engineering is studied by third-year students in the general chemistry, metallurgy, paper-making, dyeing, and brewing courses. On the other hand, the Manchester School offers certain courses of a more highly specialised nature than any given at Boston — namely, those in textile manufacture, in the bleaching, dyeing, printing, and fin-

ishing of textiles, in paper-making, in brewing, and in photography and printing. These are courses requiring special laboratories equipped with costly plant that is useful for no other purpose. The Manchester School possesses the plant because it is an exceptionally well equipped trade school as well as a school of technology, and therefore it is able to afford the necessary facilities for experimental work to students who desire the most complete scientific training which it is possible to give in such subjects.

The various engineering, testing and chemical laboratories occupy a large part of the school buildings and are as nearly perfect in their general design and equipment as they could be made by experts who had visited the principal schools of Europe and America and had almost unlimited means at their disposal. But it is with the textile departments that we are at present more particularly concerned. These may be divided broadly into two groups, (a) those which deal with the mechanical treatment of the cotton fibre, as ginning, carding, spinning, and weaving, and (b) those which deal with its chemical treatment, as bleaching, dyeing, printing, and finishing. Both are under the general supervision of the principal of the school, Mr. J. H. REYNOLDS, but are immediately controlled by professors and lecturers who have specialised in the various branches of industrial chemistry and in the different manufacturing processes.

In its extent and equipment the textile manufactures department (under the direction of Mr. T. W. FOX) far surpasses anything of the kind hitherto attempted in England, and one must go to the State textile schools of Germany to find any similar institution of equal magnitude and completeness. The school now offers a three years' day-course of theoretical and practical study in spinning and weaving (each year consisting of forty weeks of 35 hours), a five years' evening course in weaving, a three years' evening course in spinning, and a one year's lecture course (an hour and a half a week) for textile buyers and salesmen. For the evening students the year is of 30 weeks

only, and the number of working hours in the week is from 6½ to 7½.

Nearly all the textile students at the old Manchester Technical School were "occasional" students; at the new school all but four are enrolled in one or other of the regular courses. Formerly the day course was of only two years' duration; now it is spread over three years, greatly to the advantage of both teachers and students. Not all the day students, however, take the first year of the course at the school. Six of them are holders of Lancashire County Council scholarships, which are tenable for two years only, and these scholars begin the school course in its second year and specialize either in spinning or in weaving. The scholarships are awarded to the candidates, within the county, who take the highest places in the honours examination of the City and Guilds of London Institute, and of the present holders one was formerly a piecer in a spinning mill, another was a weaver, and the rest were Manchester warehousemen and clerks. Most of the other day students are the sons of employers, and their age is from 16 to 24 years. The evening students, for the most part, are already engaged in some branch of the textile business, either in mercantile houses or manufactories or with makers and exporters of textile machinery.

Some, but not many, manufacturers show their appreciation of the work which the school is doing by applying to the Principal for picked students when they have vacancies to fill, and Mr. T. W. Fox, whose experience as head of the textile industries department in the old school extends over many years, says that there is some, but not very much, evidence of an increasing desire to secure the services of men with a School training. Up to the present the school has received no official recognition or practical encouragement from the associations of cotton-trade employers, and it is said that the general attitude of the employers towards such education as the school gives is somewhat frigid. Mr. Fox tells me that the best textile student the school ever had found no better field for the exercise of his trained intelligence than a cattle ranch, and that the majority of

the most promising students have found upon leaving the school no suitable opening in the cotton manufacture, and have preferably become agents for the sale of machinery or materials used in mills. Two different conclusions might be drawn from all this. It might be said on the one hand that the manufacturers were very stupid and blind to their own interests, or on the other hand that technical education such as the school has given could be of very little practical value to the trade.

Not much good can come of the bandying of such reproaches; but it is necessary to face the facts and try to find an explanation, if not a remedy, for an admittedly unsatisfactory state of affairs. One cardinal fact is that the cotton manufacture is not a "learned industry" in the sense that the chemical and engineering industries are "learned"; there is less of pure science and more of very highly developed rule-of-thumb in its operations; and therefore, relatively, practice counts for more in it and science counts for less than in engineering, dyeing, or chemical manufacture. The value of a school training, if this be so, would appear to be proportionately less in the cotton trade. Another consideration is that the cotton manufacture of England is still to a very great extent in the hands of comparatively small firms, whose proprietors from generation to generation conduct their business themselves and either do not need highly salaried managers or think that they cannot afford to employ them. This hereditary character of the English cotton industry distinguishes it sharply from the cotton industry of the United States, which is organized in larger units under the supervision of highly paid managers. And of course it limits the opportunities for educated men who are not of the race of hereditary employers. One other important difference between the cotton manufacture and other great industries of England must not be overlooked — namely, the small number of what may be called for convenience "commissioned officers" who are employed even in a large cotton mill as compared with a mechanical or electrical engineering establishment, or a dyeworks, a printworks, or a chemical works employing an equal number of hands. Nearly

all the officers of a mill — in many cases all except the manager and the non-technical office staff — belong to the non-commissioned category, like the boatswains of ships, and the corporals and sergeants of regiments. All this probably explains why English cotton spinners and manufacturers take less interest than engineers and chemists in the work of the technical high schools or colleges. It is safe to say that technical educationists will never convert them by reproaches. It can be done only by improving the standard of technological training until the school graduate not only knows as much as the mill-trained employer but more, and so much more that he is able to increase the profits of a mill by a sum exceeding his salary. If the schools can accomplish this, their value will be speedily recognized, and their students will be in great demand; if not, they can only hope to be useful to the rank and file of the industry.

One thing at least may be taken as certain. The expert professional cotton mill manager should be much more than one well acquainted with the operations of spinning and weaving, or both. He must be something of an engineer (both mechanical and electrical) as well, and if he has studied chemistry also he will be all the better equipped. Mr. H. G. WELLS in his "Anticipations" has assigned the future conduct of all industry, to "mechanics and engineers," by which he means not men with a limited stock-in-trade of knowledge such as suffices for a joiner or an ostler, but men capable of continually mastering new points and new aspects of changing problems; men intelligent and adaptable, educated rather than trained after the fashion of the old craftsman, and having a grasp of the permanent principles that underlie the changing immediate practice. If this be true of industry generally, it is peculiarly true of an industry so vast, so varied, so highly developed on its mechanical side, yet, withal, so far from finality in its development, as the textile industry. It is therefore important to notice that the three years' course of textile study at the Manchester School of Technology is not strictly confined to spinning and weaving and calculations incidental thereto.

In the first year only ten hours a week (out of 35 hours) are devoted to practical spinning and weaving, fabric structure, and design and analysis. Of the remaining 25 hours, six are given to physics (including laboratory work), three to chemistry, four to mathematics, three to mechanics, four to geometry, two to freehand drawing, one to the study of color, and two to English. In the second year English and physics are dropped, drawing for design and ornament takes the place of freehand, and machine drawing that of geometry; textile chemistry is substituted for the elementary chemistry of the first year; there are lectures on spinning, spinning calculations, weaving calculations, weaving mechanism, and mechanical engineering, and the students spend four hours a week in the textile testing laboratory and the engineering laboratory. In the third year mathematics, weaving calculations, the study of textile ornament and color, mechanics, mechanical engineering (including laboratory) and machine drawing are discontinued, and the students turn their attention instead to the "costing" of cloth, applied design, the theory of machines, machine-testing and electrical engineering, in addition to pursuing their studies in the subjects not named as discontinued. Such a course, diligently followed by a competent student under competent teachers, ought to endow him with knowledge and trained habits of thinking exceptionally valuable in the cotton industry. Supplemented by practical experience in the working of a mill business and, of course, particularly in the organization and administration of such a business, an education of this kind should place its possessor, if he has the other non-technical qualifications, within reach of the highest positions which the cotton industry has to offer.

The equipment of the school in the department of textile industries is, as has been said, unique. The classrooms and appliances for illustrating the lectures leave little or nothing to be desired. There is a fine collection of models of textile machinery, English and foreign, and a library of technical books and journals. The magnificient Bock collection of ancient and

modern textile fabrics, which came into the hands of the Manchester Corporation many years ago, and is a duplicate of the Bock collection at South Kensington, has now found a suitable home in the School. As to the machinery in the preparation, spinning, and weaving rooms, a detailed enumeration of it would weary you. A bald inventory of the machines is given as an appendix to this paper, and it will be enough for me to say here that the school possesses a complete plant for the ginning, mixing, opening, carding, combing, and spinning of cotton, and for the doubling, gassing, reeling, and bundling of cotton yarns; for the spinning of waste cotton, for the preparation of cotton and mixed yarns for weaving, for weaving cotton and mixed goods on hand looms and power looms, for silk reeling, throwing, preparing, and weaving by hand and power, and for the chemical, mechanical, and microscopical testing of fibres, yarns, and cloth. The weaving sheds contain 25 hand looms and 37 power looms for cotton and 10 hand looms and 9 power looms for silk, including looms of English, American, and Continental make, suitable for almost every variety of weaving. The textile testing laboratory alone contains 63 machines or appliances, namely 18 scales and balances, three wrap reels three microscopes, two lea-testers, three single thread testers, two cloth testers, three water-bath ovens, three conditioning stoves, three twist-testers, and three hygrometers. The educational value of such a testhouse is obvious, and its practical commercial utility in a city like Manchester is also apparent. The school is at all times glad to test and report on materials furnished by manufacturers and merchants, the only stipulation made being that the results shall not be used in connection with litigation.

The department of chemistry at the Manchester School of Technology is subdivided into five sections, in every one of which there is a regular course of study leading to a diploma at the end of three years. The five sections are (1) general technical chemistry, (2) bleaching, dyeing, calico printing, and finnishing, (3) papermaking, (4) brewing, and (5) metallurgy. The whole department is under the direction of Professor W. J.

POPE, a Fellow of the Royal Society, with whom is associated Professor E. KNECHT, a chemist trained at the famous technical college at Zurich and formerly on the teaching staff of the Bradford Technical College. The courses of study have been designed to lay a foundation of pure science and afterwards to teach the student, by experiment, "How scientific principles may be applied to the operations and in the development of industrial chemistry." The first of the three years of the course is, therefore, spent in studying the subjects common to all the scientific courses of the school — namely, mathematics, drawing and geometry, mechanics, physics, chemistry, workshop exercises, German, and English. A student may thus complete his first year before declaring whether he will proceed to one of the engineering or one of the chemical courses. In the second year, however, the courses diverge, and there is specialization not only in chemistry (or engineering) but also in the different branches of chemical technology.

The same liberality and scientific care which have been noticed already in the equipment of the engineering and physical departments are evident in the department of chemistry, which compares well in nearly all respects with any other chemistry school in England, and particularly well in its provision for the study of applied chemistry. The principal lecture theatre has seats for 170 students, and is provided with a powerful experimental projection lantern and all the usual accessory fittings. Two smaller lecture-rooms accommodate respectively 50 and 30 students, and the preparation-rooms attached to these three theatres are supplied with all the apparatus necessary for illustrating the lectures and with collections of specimens, lantern slides, and diagrams. The principal inorganic laboratory has benches for 80 students, whilst 64 students can work together in the large organic laboratory. This laboratory contains a large model Fluess pump provided with a drying apparatus cooled by liquid air, for use in distillation under very low atmospheric pressures. There are also centrifuges and mechanical shaking, stirring, and grinding appliances, driven electrically,

An auxiliary laboratory has been fitted up for research work in organic chemistry, and there is a large "stink" laboratory on the roof of the building. Another room contains combustion and Carius furnaces for use in organic analysis, and a number of autoclaves of varied patterns and sizes. There are also a very finely equipped physical chemistry laboratory and laboratories for gas analysis, water analysis, etc. The laboratories of this department are supplied with water, gas, electric power, steam, hydrogen sulphide, compressed air and vacuum flues, and are fitted with drying ovens, sand baths, evaporating cupboards with glass doors, and a distilled-water plant worked by steam from the main boilers.

Perhaps the most important section of the chemistry department is that devoted to dyeing and the allied applications of chemistry. The laboratory work and lectures in this section are under the immediate direction of Dr. KNECHT, and the dye-house, which is at the same time a miniature bleaching, calico-printing, and finishing works, is in charge of Mr. J. HUBNER. Second-year students of dyeing, after becoming acquainted with the chemical and physical properties of textile fibres, enter upon a course of experimental work in the dyeing laboratory. This laboratory can accommodate thirty students, and is fitted with experimental dye-baths, color-pans, and drying cupboards, heated by steam. Special care has been taken to secure absolute cleanliness in the work. The dye-baths — sunk in the benches — are made of white glazed pottery instead of the usual iron or copper, and they have enamelled iron lids. They are heated by steam coils — a system now almost universal in Continental works, but little used in England, — and the difficulty of securing an absolutely even heating of the baths has now been overcome by Dr. KNECHT, who has hit upon a simple but efficacious contrivance for the purpose. For work requiring gas instead of steam there are benches along two walls of the room. For the matching of colors the laboratory contains an installation of different kinds of artificial light — namely, electric arc light, electric light from a "Dalite" lamp, incandescent gas,

ordinary batswing gas, and candle. Another item of the equipment is a model calico-printing machine, worked by hand. Connected with the dyeing laboratory are a pattern-room and research laboratory. Research work will be directed not so much to the discovery of new dyes (a field already occupied by hundreds of highly trained research chemists in Germany) as to finding out the best uses of new dyes and improved methods of applying them.

In the dyeing laboratory the students are trained in exact and scientific methods of work; in every experiment, for instance, they are required to weigh the coloring matter and the yarn or fabric to be dyed, measure the water and the time, take the temperature, and record everything for the purposes of reference and comparison. They thus learn the effects of excess in the use of reagents, of a greater or less quantity of water, of varying temperatures, and of the duration of treatment. They practise "mercerizing" on an experimental scale, and become acquainted with the properties and uses of the various kinds of commercial dyes, such as the anilines, the alizarine mordants, benzo-purpurine, and so forth. A technical knowledge of these and kindred matters is, of course, necessary to a dyer, but even in ordinary mercantile transactions it is exceedingly important to be able to distinguish between, say, an alizarine red, a paranitraniline red which resembles it closely, and a benzo-purpurine which may match it exactly but will not keep its color.

Third-year students of dyeing study colorimetry, the spectrum analysis of dyestuffs, the chemistry of coloring matters, alkali manufacturing, chemical engineering, spinning and weaving, and building construction, but 25 hours out of the 35 in the school week are now divided between the chemical laboratory and the dyehouse. The dyehouse, which is a separate building beside the main school building, is one of the most remarkable features of the institution, and is probably the best workshop of its kind possessed by any technological college in the world.

The dyehouse covers an area of more than twelve hundred square yards. The machinery which it contains has for the

most part been specially designed and constructed, and is intended for experimental and research work on an industrial scale in the bleaching, dyeing, printing, and finishing of cotton textiles and the manufacture, dyeing, and finishing of paper. For the treatment of raw cotton and yarn there is a very fine plant, which comprises machines for dyeing loose cotton, appliances for bleaching yarn and warps, yarn dyebecks, cop-dyeing machines, a yarn mercerizer, a Klauder-Weldon dyeing machine, a one-and-two-color yarn printing machine, a one-two-and-four-color warp dyeing machine, a warp sizing machine, an indigo dyeing machine for warps, drying machines, a hydro extractor, and a polishing machine. The plant for bleaching, dyeing, printing, and finishing cloth is even more extensive. It consists of a singeing machine with both gas and hot plates, a shearing machine, a high pressure kier, "chemic" and "sour" cisterns, a water mangle, a scutcher, a squeezer, dye jiggers, drying cylinders, a starching range, a friction calender, an embossing calender, a hydraulic mangle, a hot press, a raising and felting machine for flannelettes, a steaming and brushing machine, a damping machine, a 30-foot jigging stenter with a Sturtevant heater and ventilator, a cloth mercerizing machine, a color straining machine, a preparing and chloring range, an open soaper, a three-color printing machine, a plaiting machine, a padding machine, dyebecks, a high-pressure steaming cottage, an aniline ager, and a beetling machine.

The hydraulic mangle is a German machine scarcely known as yet in England; in fact, the first two for use in Britain were ordered quite recently. It produces a finish which may be described as something between a beetle-finish and a calender-finish. The damping machine is fitted for both spray and brush damping, and has also a beaming attachment. The three-color calico printing machine is driven by an electric motor with direct gearing, and is of the most modern type. In order that experiments may be made with the machine running at different speeds the pace can be varied from 30 per cent. faster to 30 per cent. slower than the normal. For the preparation of bleaching

liquor from an ordinary salt solution there are two electrolysers, with carbon and platinum electrodes respectively. This method of producing bleaching liquor has come into favor in German works, and it is proposed to make comparative tests with this and with the ordinary bleaching powder as used in England. For the practical study of the "Schreiner" finish, which enhances the silky lustre of mercerized cotton fabrics, a hydraulic Schreiner calender has been included in the equipment of this department. A dark room opening out of the dyehouse will be fitted up with a row of boxes containing every kind of artificial light for testing and matching colors; for the rapid exposure of colors so as to test their fastness to concentrated light under conditions approaching the effect of sunlight there is an electric apparatus of about 30,000 candle power. A "making-up room" and "grey-room" are contained in the same building.

The most noticeable difference between the schemes of equipment in the dyehouses here and in the great German schools lies in their scope. At Crefeld the attempt was made to provide appliances for the treatment of all kinds of textile fibres — cotton, wool, flax, hemp, jute, and silk. The Manchester school has specialized in cotton and to some extent in silk, which is largely used in the cotton manufacture. The new Prussian schools represent the opposite extreme to that adopted at Crefeld, the newest of all, namely the textile school at Munchen-Gladbach, having been devoted exclusively to flannelettes and cheap "unions." The Manchester school authorities believe, not without reason, that they have chosen the happy mean. It is certainly flattering to the School, as well as symptomatic of the keen and intelligent interest taken in technical education by the Continental nations, that the Manchester laboratories and dyehouse are already attracting students from abroad. A case in point is that of a young Austrian who has come to Manchester from Vienna to study dyeing because the Manchester equipment is the newest, and therefore presumably the most modern, in the world. It was suggested that he had better wait for a few months until the new dyehouse should be ready, but he

answered that he would rather come at once and spend the meantime in studying English.

The bleaching, dyeing, and calico-printing trades of England are now mainly in the hands of large associations, which have it in their power to encourage the scientific study of their various industrial processes as they have never yet been studied in this country, and so to protect these industries against the danger of technical stagnation. It is obvious that if each of the three great "combines" (The Bleachers' Association, The Bradford Dyers' Association and The Calico Printers' Association) were to send every year to this school half a dozen picked young men of good general education and a little practical experience, retaining them in their employment and paying their salaries and fees during the full school course, a great deal might be done to improve the intellectual equipment of their works. This is the way in which the Russian government secures a supply of highly trained foremen and managers for the great paper mills at St. Petersburg in which bank notes and the paper of every kind used in all the state departments are manufactured. The government maintains in connection with the mills, a school in which the most promising boys are taught mathematics, mechanics, and chemistry for three years, their wages being paid all the time by their employer (the state), and opportunities for experimental work being afforded in the mills themselves. Sir WILLIAM MATHER, in urging a somewhat similar policy upon the British Calico Printers' Association, has said, "In the absence of such a department [of education and research work] I fail to see how this great association is to be supplied continually, as time goes on, with the requisite men of trained intelligence to conduct its operations on the productive side with that degree of excellence and economy necessary to meet the competition of the highly organized and equipped calico printing works with which I am acquainted in other countries."

It is, however, already apparent that even a three years' course (formerly it was two years) is too short for students of industrial chemistry, and that far better results could be gained if the

course were increased to four years, as was done some time ago at Zurich. Three years of thorough training in mathematics, mechanics and physics, and in pure chemistry, followed by a year in the dye house and dyeing laboratory, are not too much for a young man who desires to qualify himself for the management of a dyeworks or printworks.

APPENDIX.

THE MANCHESTER SCHOOL OF TECHNOLOGY.

Equipment for Cotton Spinning.

Typical cotton gins,	4	machines.
Roller, and hopper bale breakers, mixing lattices, and cotton bins,	2	"
Willow, compound opener with hopper feed and lap attachment, single scutcher,	3	"
Revolving flat, roller and clearer, and condensing cards,	4	"
Sliver lap, ribbon lap, and combers,	4	"
Drawing frame,	4	heads.
Slubber, intermediate, rover, and jack frames,	4	machines.
Waste, medium and fine mules, and mule headstock,	4	"
Twist and weft ring frames,	2	"
Doubling winder, ring doubler, and twiner,	3	"
Clearing, gassing, reeling, preparing, and bundling,	5	"
Roller covering plant,	10	"

Flat, roller and cylinder, stripping, grinding, and burnishing machinery.
Experimental machines, working models, and flat fastenings.
Mill plans, and arrangements of machinery.
Specimens of coarse, medium, and fine, grey, and colored cotton in various stages of preparation.

General Equipment of the Preparation Department.

Winding machines for warp and weft.
Mill, beam, and sectional warping machines.
Yorkshire dressing frames.
Running-off frame for sectional warping.
Drawing-in and twisting frames.
Piano card cutting machine.
Dobby card punching frame.
Lacing frame.

General Equipment of the Weaving Shed.

Hand Looms.

Treadle loom,	1
Dobby looms,	11
Jacquard looms,	12
Pattern loom,	1
	25

Power Looms.

Lappet looms, single box,	9
" " multiple boxes,	3
Dobby " single box,	4
" " multiple boxes,	5
Jacquard " single box,	3
" " multiple boxes,	7
Lappet "	1
Terry "	2
Plush "	1
Automatic "	2
	37

Equipment for Silk Spinning and Preparation.

Cotton reeling,	2
Hard silk — winding, cleaning, doubling spinning and throwing machines,	5
Hard silk reeling,	1
Soft silk — winding, re-drawing, pirn winding,	3
Mill and sectional warping,	2
Winding on,	1
Reel steaming chest,	1
Reel stand,	1
Drumming and deniering scales,	2
Splitting rices,	2
Boiling pan, steeping tub, and soap cutter,	3
	23

Silk Weaving.

Hand looms —	Treadle,		2
	Jacquard,		7
	Ribbon,		1
Power looms—	Tappet,	single box,	1
	Dobby,	single box,	1
	"	multiple boxes,	1
	Jacquard,	single box,	2
	"	multiple boxes,	3
	"	swivel,	1
			19

EQUIPMENT OF TEXTILE TESTING LABORATORY.

Wrap reels,	3
Scales and balances,	18
Microscopes,	3
Lea testers,	2
Single thread testers,	3
Cloth testers,	2
Water bath ovens,	3
Conditioning stoves,	3
Twist testers,	3
Hygrometers,	3

FIGURE 1.—MUNICIPAL SCHOOL OF TECHNOLOGY, MANCHESTER, ENGLAND.

FIGURE 2. — ENTRANCE TO SCULPTURE HALL.

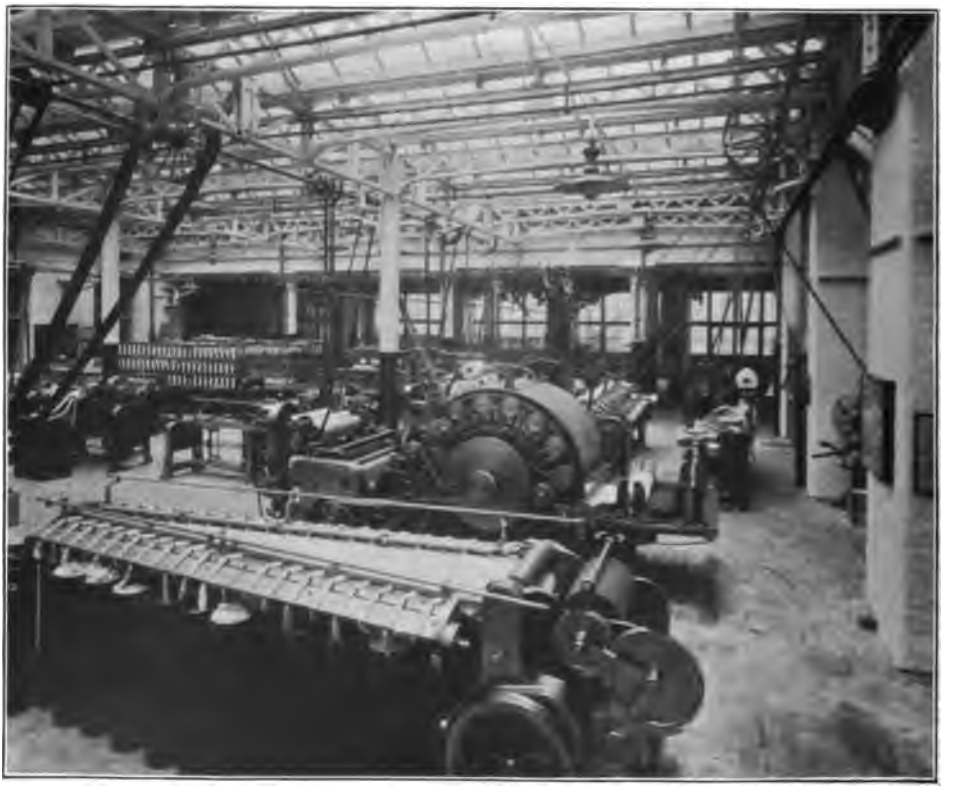


FIGURE 3. — SPINNING ROOM.

FIGURE 4. — SPINNING ROOM. MULES.

FIGURE 5. — SPINNING ROOM. COMBERS.

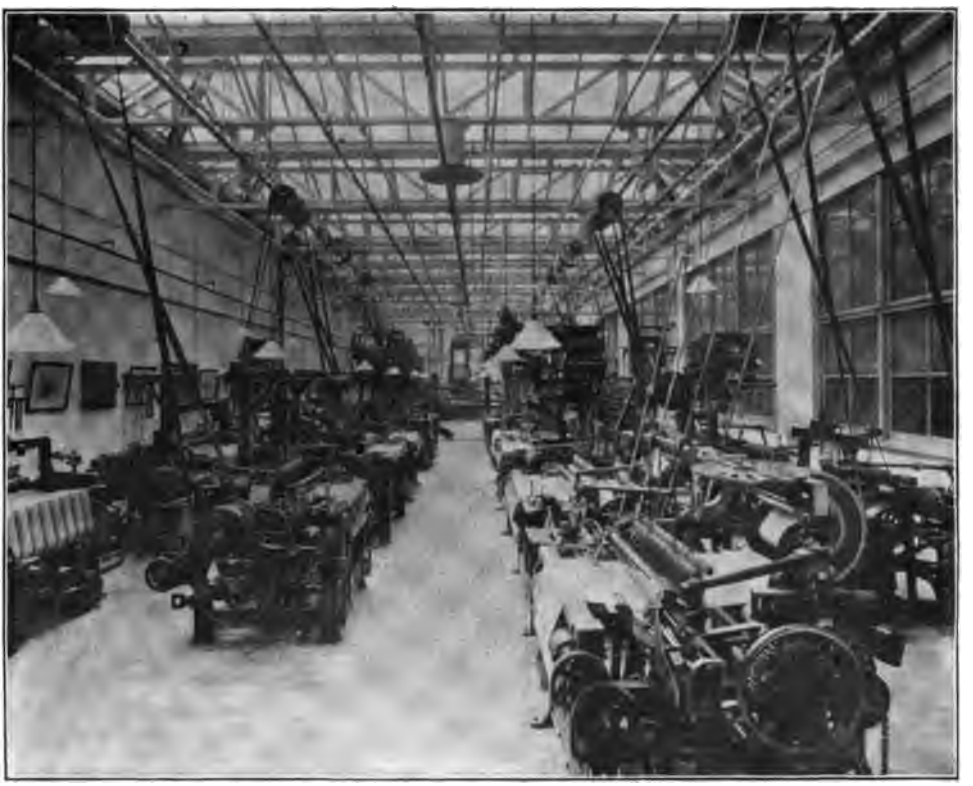


FIGURE 6. — WEAVING SHED. POWER LOOMS. WEAVING PREPARATION IN THE DISTANCE.

FIGURE 7. — HAND LOOM WEAVING ROOM.

FIGURE 8. — DYEING LABORATORY.

The SECRETARY. In this connection I would state that Sir SWIRE SMITH, the English worsted manufacturer who was knighted by Queen Victoria on the occasion of her jubilee for his great work on the advancement of Technical Education, is just finishing a trip to this country and we expected to have him with us to discuss the question of technical education in Europe. But he sails tomorrow from New York and was obliged to leave Boston on Tuesday and to defer his cherished wish of attending this meeting of the Association, and I take this opportunity to extend his regrets.

The PRESIDENT. Some two weeks ago I visited this Manchester Textile School in Manchester, England, went all over the building and briefly studied their methods of instruction. The building itself and its equipment is magnificient. It is unfinished in some respects, and among some of the English manufacturers I heard some criticism not only as to instruction but the instructors. I think the school is destined to do magnificent work, and from my point of view it seems to be doing it now. But to tell you exactly as it was given me, it has not yet developed into that condition which they hope it will reach in the near future.

Is there anything further to be said on these papers — on this subject? If not we will pass to the next paper, The Use of Reheaters in Compound Engines, Mr. GEORGE H. BARRUS, Boston, Mass.

*THE USE OF REHEATERS IN COMPOUND ENGINES.

GEORGE H. BARRUS, Boston, Mass.

The primary object of using a reheater in connection with a compound engine is to reduce the loss occasioned by cylinder condensation. In this paper, I wish to show to what extent reheaters are advantageous for this purpose, basing my conclusions on the data afforded by some of my engine tests.

In the first place, let us consider how cylinder condensation reveals itself and how much loss it produces. In doing this it is unnecessary to enter deeply into the subject, for a brief explanation will suffice to make the paper understood even by those who may not be specially familiar with steam engineering problems.

If we take an indicator diagram from a steam engine cylinder, it is a simple matter to compute from it the quantity of steam which is present in the cylinder during certain portions of the stroke. If this quantity is then compared with the actual amount of steam admitted into the cylinder from the boiler, as determined by a test of the feed water consumption, it will be found that there is a considerable discrepancy between the two figures, the steam computed from the diagram being always less than the quantity actually used. The shortage in the weight of steam found in the cylinder is caused primarily by cylinder condensation, and it is the result of a powerful cooling action which

* For further references on this subject see Transactions as follows: Vol. 39, p. 40, HAMILTON A. HILL, High Speed Engines; Vol. 42, p. 18, JOHN T. HENTHORN, Compound Engines; Vol. 58, p. 91, RICHARD H. RICE, Vertical Engines.

at all times accompanies the working of steam within the engine. The causes of cylinder condensation need not be discussed at this time. It is sufficient for the present purpose to say that the loss which it produces bears no small proportion to the total weight of steam actually consumed. It varies in different engines and in the same engine working under different conditions, but it is seldom less than 20 per cent., and, under certain conditions of the load it may reach as high as 50 per cent. It is true that leakage of valves and pistons causes a loss which is revealed by the same computation, but these statements do not apply to defective engines. They apply to tight or nearly tight simple engines, and it may be added also, to cases where the steam is supplied in its ordinary condition without superheating.

The loss from cylinder condensation occurs in all kinds of steam engines, whether simple or multiple-expansion, assuming, of course, that no means are taken to prevent it. In compound engines, the loss is not confined to one cylinder but it occurs in both the high pressure and the low pressure cylinders. It is not, as a rule, distributed equally between the cylinders, but it is generally greater in the low pressure cylinder than in the high pressure cylinder. The extent of the loss and its distribution may best be exhibited by referring to the results of a number of tests, made by the writer on fairly tight Corliss compound engines, which are given in the following table:

Size of Engine.	Revs. per Minute.	Percentage of Loss by Cylinder Condensation.	
		High Pressure Cyl.	Low Pressure Cyl.
Inches.			
26 & 48 x 48	52	22.6 per cent.	27.7 per cent.
16 & 32 x 48	75	23.3 "	36. "
22 & 44 x 60	68	21.1 "	24.2 "
28 & 48 x 60	70	23.8 "	29.2 "
18 & 30 x 48	65	28.3 "	40. "
Average,		23.8 per cent.	31.4 per cent.

In these tests the loss is expressed in percentage of the actual consumption of feed water, and it applies to a point on the diagram a little later than the cut-off. The percentages for the

high pressure cylinder range from 21.1 per cent. to 28.3 per cent., and those for the low pressure cylinder from 23.7 per cent. to 40 per cent.; the averages, in the instances cited, being respectively, 23.8 per cent. and 31.4 per cent.

Reverting now to my subject, the reheater is a device placed in the path of the exhaust pipe of the high pressure cylinder, and, as its name indicates, it reheats the steam passing through that pipe before it enters the low pressure cylinder and thereby reduces the condensation in that cylinder. The apparatus is merely a shell, or chamber, through which the steam flows, and it is provided with live steam pipes or coils supplied from the boilers, and upon these it depends for its source of heat. In its general features, the apparatus resembles the feed water heater applied to a boiler plant, although used for a different purpose.

In view of the fact that the loss from condensation is noticeably greater in the low pressure cylinder than in the high pressure cylinder, being, in the instances just referred to, no less than one-third more in the one than in the other, there seems to be good ground for employing special means, such as the reheater furnishes, for securing the object in this part of the engine, whatever may be done for the engine as a whole. The reheater is admirably adapted to this particular purpose, for it can be conveniently applied at the point where its work is most needed; and, what is more, the steam to be operated upon is at such a comparatively low pressure that the heat which it uses can be most effectively derived from the boiler steam.

The principle on which the action of the reheater depends is the re-evaporation of the water and moisture contained in the exhaust steam discharged from the high pressure cylinder, and further, in cases where the extent of reheating surface is sufficient, the superheating of the whole quantity exhausted. The effect of this action is to increase the quantity, volume, and dryness of the steam supplied to the low pressure cylinder, and the result is two-fold; first, an increase in the relative amount of power developed by this cylinder on account of the new supply of steam produced; and second, the use of the steam with increased efficiency, owing to the saving of cylinder condensa-

tion due to its dryer condition. The reheater tests to which I will refer show these actions in detail, and the matter can best be discussed by taking up the tests at once. These tests were made on three independent engines. In each case one test was made with the reheater in complete operation, and one with the heating pipes shut off, which practically threw the reheater out of use.

The first engine is a Greene horizontal cross-compound, having unjacketed cylinders 26 and 50 by 60 inches. The steam was slightly superheated, being furnished by Manning boilers. An independent air pump operated the condenser and the quantity of steam it used was ascertained and allowed for. The data and results are given in Table No. 1.

The results of the tests given in Table No. 1 show a substantial agreement between the total quantity of feed water consumed per indicated horse power per hour, whether the reheater was on or off. In other words, so far as the question of economy in steam consumption is concerned, no advantage was produced by the reheater. This surprising result occurred notwithstanding the fact that the reheater caused a marked improvement in the action of the steam in its passage through the cylinders. It appears that the reheater actually did reduce the condensation in the low pressure cylinder, thus securing at this point the expected gain. When it was in use, the condensation here (see lines 19 and 20) was 4.4 per cent. greater than in the high pressure cylinder. When the reheater was not in use the difference was 10.6 per cent. Although there was a saving within the cylinder, nevertheless the loss of steam due to that condensed in the reheating pipes to accomplish this result was so great that the net economy was reduced to zero.

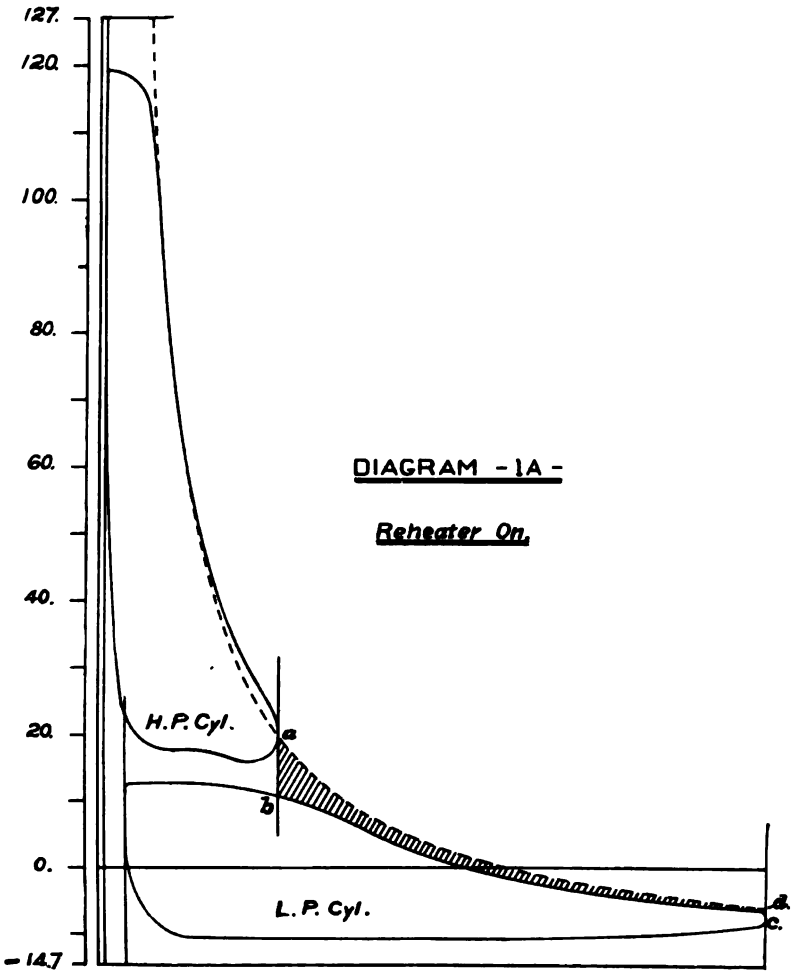
The effect of the reheater upon the power developed by the low pressure cylinder is most noticeable. With practically the same power in the high pressure cylinder in the two cases (the difference being only 2.1 horse power) that developed in the low pressure cylinder was 35.5 horse power less when the reheater was off than when it was in use. This effect is well

TABLE No. 1.

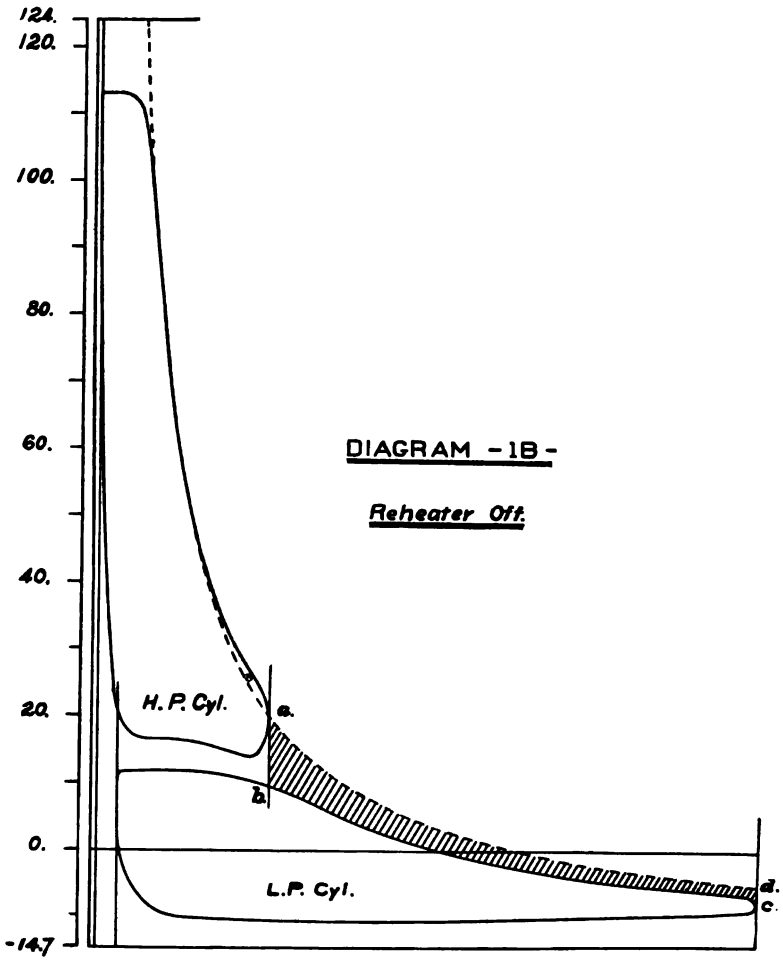
26 and 50 x 60 inch Greene Engine. Ratio of cylinder volumes 3.69 to 1.

			TEST 1A. Reheater On.	TEST 1B. Reheater Off.
1.	Steam pipe pressure,	Lbs.	125.9	121.5
2.	Number of degrees of superheating,	Deg.	12.	13.
3.	Reheater pressure,	Lbs.	11.4	10.1
4.	Vacuum,	In.	27.	27.
5.	Revolutions per minute,		77.	76.7
6.	Mean effective pressure, high pressure cylinder,	Lbs.	46.11	46.47
7.	Mean effective pressure, low pressure cylinder,	Lbs.	12.08	11.34
8.	Indicated horse power developed by high pressure cylinder,	H. P.	562.7	564.8
9.	Indicated horse power developed by low pressure cylinder,	"	544.	508.5
10.	Indicated horse power developed by whole engine,	"	1,106.7	1,073.3
11.	Weight of feed water consumed per hour,	Lbs.	15,522.	14,975.
12.	Weight of feed water consumed per indicated horse power per hour,	"	14.02	13.95
	MEASUREMENTS BASED ON SAMPLE DIAGRAMS.			
13.	Proportion of stroke completed at cut-off, high pressure cylinder,		.294	.31
14.	Proportion of stroke completed at cut.off, low pressure cylinder,		.326	.326
15.	Weight of steam accounted for by indicator at cut-off, high pressure cylinder,	Lbs.	11.32	11.8
16.	Weight of steam accounted for by indicator at cut-off, low pressure cylinder,	"	10.71	10.32
17.	Percentage of feed water accounted for at cut-off, high pressure cylinder,	Percentage	80.9	84.3
18.	Percentage of feed water accounted for at cut-off, low pressure cylinder,	"	76.5	73.7
19.	Percentage of cylinder condensation and leakage, high pressure cylinder,	"	19.1	15.7
20.	Percentage of cylinder condensation and leakage, low pressure cylinder,	"	23.5	26.3
21.	Percentage of steam condensed in reheating pipes,	"	4.	0.

The quantities given for Test 1A in lines 11, 12, 19, and 20, include the steam condensed in the reheating pipes.



shown in the appended diagrams 1A and 1B. These are what are called "Combined" diagrams, being constructed from sample indicator diagrams actually taken during the tests. They show these diagrams placed in their proper relative positions, reduced to the same relative length as the relative volumes of the cylinders, and using the same scale of pressure. On each diagram a hyperbolic curve is drawn through the point of cut-off



of the high pressure cylinder, representing a theoretical expansion line. The effect of the reheater is seen in the amount which the low pressure diagram falls away from this curve. To bring out this feature clearly, the space between the hyperbolic curve and the upper portion of the low pressure diagram is shaded. It will be seen at a glance that the shaded area a, b, c, d, is considerably the greater in the case where the reheater was

shut off. This loss of area is indicative of the real loss of power which the absence of reheating produces. The difference between the shaded areas in the two cases compared with the area of the low pressure diagram is 9.8 per cent., and compared with the combined area of the two diagrams, 4.6 per cent.

The second engine is a Corliss horizontal tandem compound, with unjacketed cylinders 18 and 40 by 48 inches, made by the Hewes & Phillips Iron Works. The steam was supplied from Cahall vertical boilers. The amount of heating surface in the reheater was 75 square feet. The condenser was of the siphon class and no steam was used for operating it. The data and results of the tests on this engine are given in Table No. 2.

The results of the tests given in Table No. 2, show that the consumption of feed water is almost identically the same whether the reheater pipes were in use or out of use, thus bearing out the results given in Table No. 1. There is, however, a greater action going on in the cylinders as the effect of the reheater than in the first engine. The condensation in the low pressure cylinder, when the reheater was on, was 1.3 per cent. less than that in the high pressure cylinder. When the reheater was off, it was 9.2 per cent. more in the low pressure cylinder than in the high pressure cylinder, thus making a total difference amounting to 10.5 per cent. There is also greater effect upon the low pressure power. With the reheater on, the low pressure cylinder developed 58.7 horse power more than the high pressure, whereas, with the reheater off, it developed 19.7 horse power less, making a total difference due to the reheater of 78.4 horse power. This important effect is also shown by examining the appended "Combined" diagrams 2A and 2B, which have been prepared from sample indicator diagrams taken during these tests, and constructed like those referred to in the case of the first engine. The difference in the shaded areas *a*, *b*, *c*, *d*, of these two diagrams, which represents the true effect produced by the reheater on the power developed by the low pressure cylinder, is 14.4 per cent. of the area of the low pressure diagram, or 6.3 per cent. of the combined area of the two diagrams.

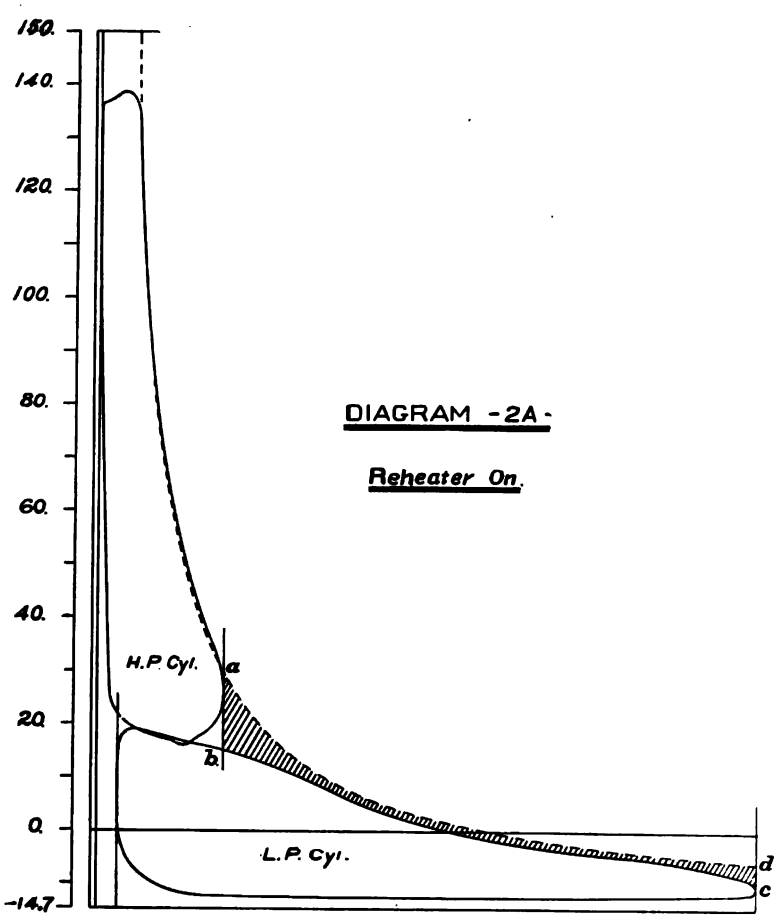


DIAGRAM -2A-

Reheater On.

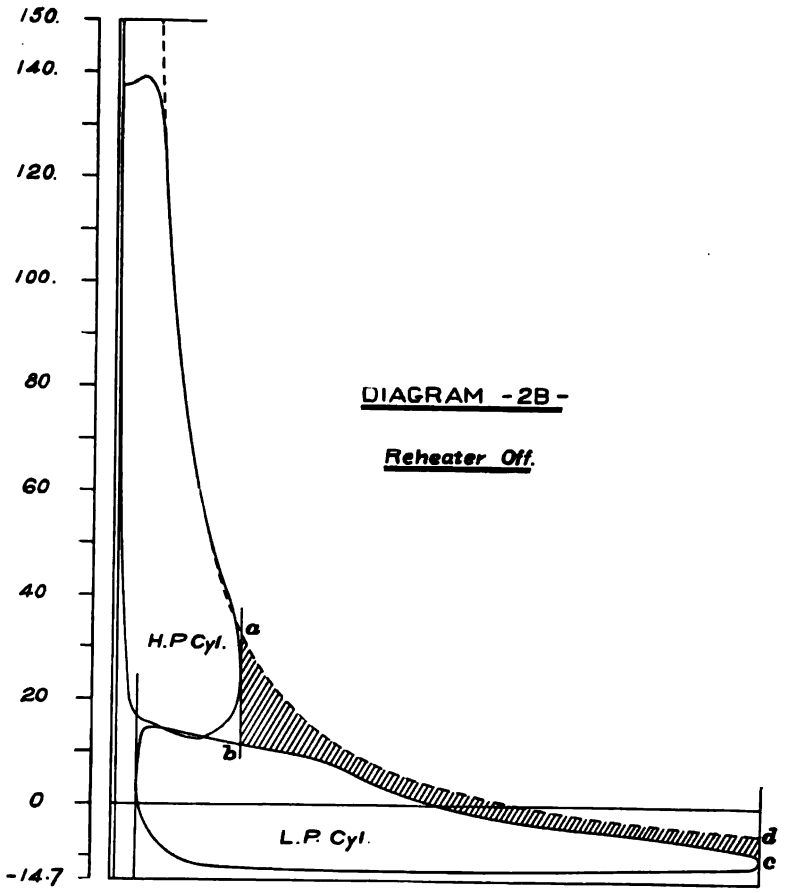


DIAGRAM -2B-

Reheater Off.

TABLE No. 2.

18 and 40 x 48 inch Corliss Engine. Ratio of cylinder volumes 5 to 1.

			TEST 2 A. Reheater On.	TEST 2 B Reheater Off.
1.	Steam pipe pressure,	Lbs.	145.4	144.5
2.	Reheater pressure,	"	18.4	14.5
3.	Vacuum,	In.	26.9	26.6
4.	Revolutions per minute,		73.2	73.
5.	Mean effective pressure, high pressure cylinder,	Lbs.	61.83	73.47
6.	Mean effective pressure, low pressure cylinder,	"	15.03	13.82
7.	Indicated horse power developed by high pressure cylinder,	H. P.	271.6	321.9
8.	Indicated horse power developed by low pressure cylinder,	"	330.3	302.2
9.	Indicated horse power developed by whole engine,	"	601.9	624.1
10.	Weight of feed water consumed per hour,	Lbs.	8,028.	8,329.
11.	Weight of feed water consumed per indicated horse power per hour,	"	13.34	13.35
	MEASUREMENTS BASED ON SAMPLE DIAGRAMS.			
12.	Proportion of stroke completed at cut-off, high pressure cylinder,		.306	.357
13.	Proportion of stroke completed at cut-off, low pressure cylinder,		.301	.349
14.	Weight of steam accounted for by indicator at cut-off, high pressure cylinder,	Lbs.	9.67	10.92
15.	Weight of steam accounted for by indicator at cut off, low pressure cylinder,	"	9.84	9.66
16.	Percentage of feed water accounted for at cut-off, high pressure cylinder,	Percentage	72.7	81.8
17.	Percentage of feed water accounted for at cut-off, low pressure cylinder,	"	74.	72.6
18.	Percentage of cylinder condensation and leakage, high pressure cylinder,	"	27.3	18.2
19.	Percentage of cylinder condensation and leakage, low pressure cylinder,	"	26.	27.4
20.	Percentage of steam condensed in reheating pipes,	"	8.7	0

The quantities given for Test 2 B in lines 10, 11, 18, and 19, include the steam condensed in the reheating pipes.

The third engine is a Corliss horizontal cross-compound, with steam jacketed cylinders 16 and 40 x 48 inches, built by C. & G. Cooper Company. The steam was supplied in a superheated condition from Manning boilers. The independent air pump was operated from a separate boiler. In this engine the high pressure cylinder was jacketed both on the heads and around the barrel. The low pressure cylinder was jacketed only on the heads. On both tests, the steam was shut off from all the jackets and the engine operated as an unjacketed machine. The reheater contained about 550 square feet of heating surface. The data and results are given in Table No. 3.

Here again in Table No. 3 we have practically the same consumption of feed water per indicated horse power, whether the reheater was in use or not. Here, also, we have the same kind of effect produced by the reheater as regards the reduction of cylinder condensation and increase of power in the low pressure cylinder, as in the two previous engines, but in this case the actions are even more marked. The difference between the condensation in the two cylinders with the reheater in use was 1.2 per cent., being less in the low pressure cylinder than in the high pressure cylinder, but with the reheater out of use there was 17.1 per cent. more condensation in the low pressure cylinder than in the high pressure cylinder, making the total difference in the two cases 18.3 per cent. This improvement is a large one, but it is evident that so large a quantity of steam was required to be condensed in the reheater to produce it that all the advantage was lost. It may be noted here that in this engine the amount of heating surface in the reheater was so great that the steam entering the low pressure cylinder was superheated 38 degrees, but even this failed to secure a net saving of steam by the operation.

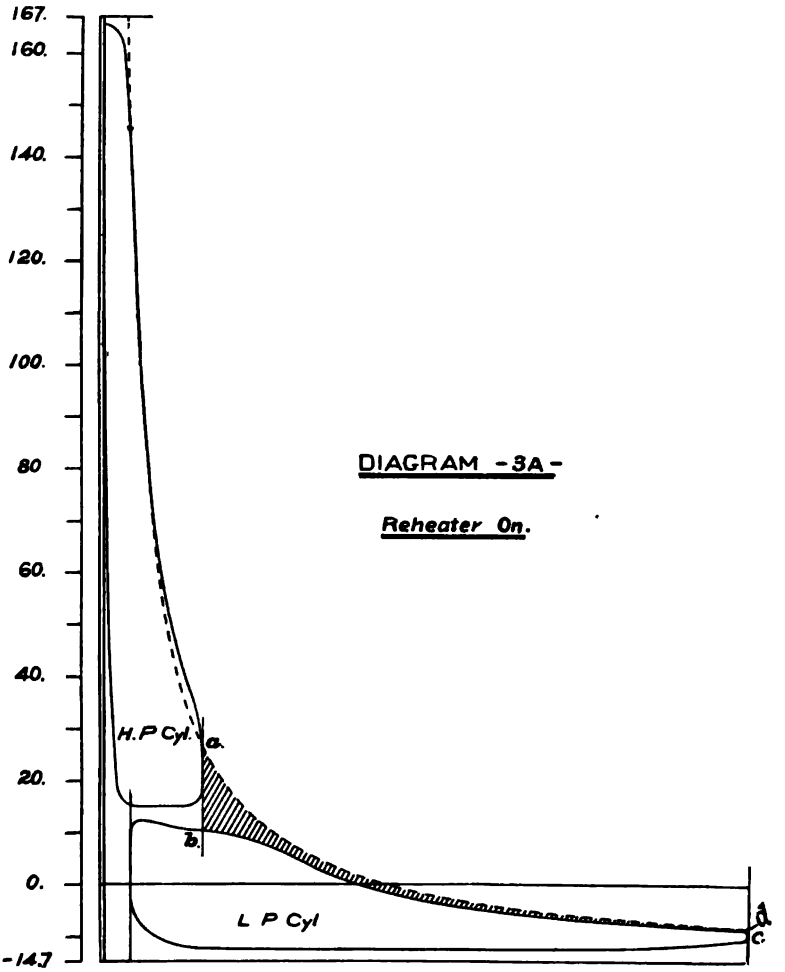
The effect upon the low pressure power was quite as marked as that upon the condensation. With the reheater on, the low pressure cylinder developed 18.7 horse power more than the high pressure cylinder. With the reheater off, it developed 40 horse power less than the high pressure cylinder, making a total

TABLE No. 3.

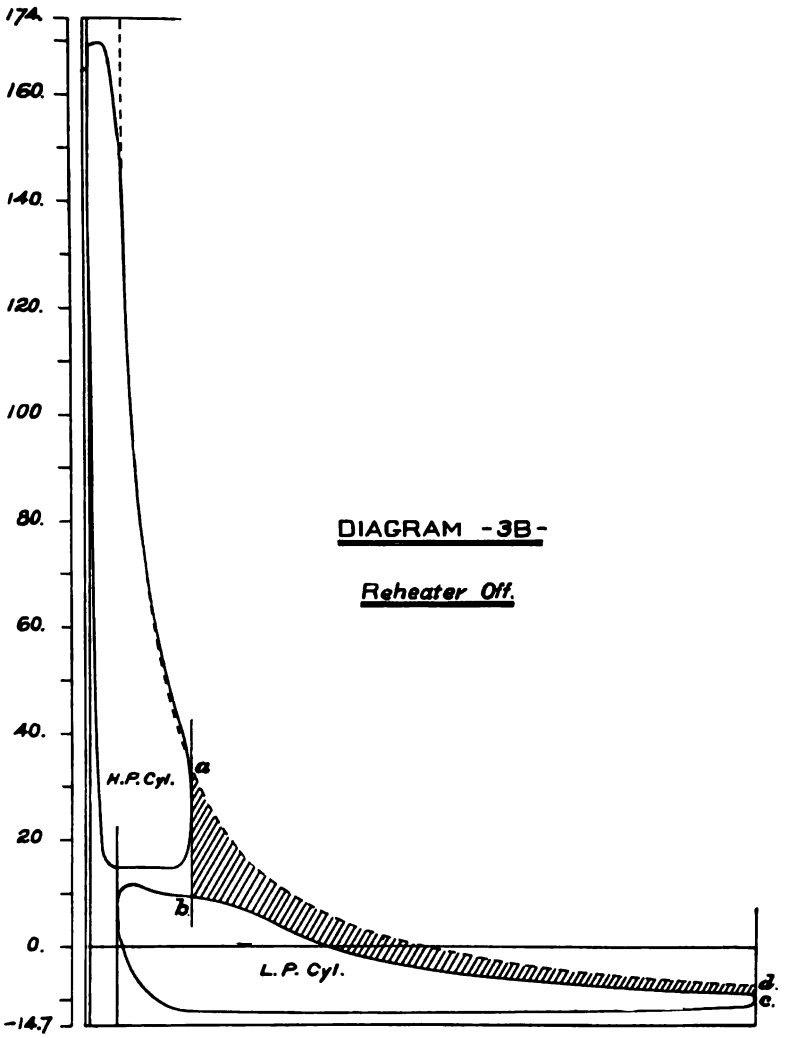
16 and 40 x 48 inches Corliss Engine. Ratio of cylinder volumes 6.29 to 1.

			TEST 3 A. Reheater On.	TEST 3 B. Reheater Off.
1.	Steam pipe pressure,	Lbs.	172.2	171.9
2.	No. of degrees of superheating,	Deg.	46.	41.
3.	Reheater pressure,	Lbs.	13.3	13.2
4.	Vacuum,	In.	27.7	28.
5.	Revolutions per minute,		80.2	80.1
6.	Mean effective pressure, high pressure cylinder,	Lbs.	70.79	78.81
7.	Mean effective pressure, low pressure cylinder,	"	12.01	10.81
8.	Indicated horse power developed by high pressure cylinder,	H. P.	273.2	303.5
9.	Indicated horse power developed by low pressure cylinder,	"	291.9	263.4
10.	Indicated horse power developed by whole engine,	"	565.1	566.9
11.	Weight of feed water consumed per hour,	Lbs.	6,340.5	6,401.7
12.	Weight of feed water consumed per indicated horse power per hour,	"	11.22	11.29
	MEASUREMENTS BASED ON SAMPLE DIAGRAMS.			
13.	Proportion of stroke completed at cut-off, high pressure cylinder,		.278	.285
14.	Proportion of stroke completed at cut-off, low pressure cylinder,		.281	.248
15.	Weight of steam accounted for by indicator at cut-off, high pressure cylinder,	Lbs.	8.97	10.
16.	Weight of steam accounted for by indicator at cut-off, low pressure cylinder.	"	9.11	8.07
17.	Percentage of feed water accounted for at cut-off, high pressure cylinder,	Percentage	80.	88.6
18.	Percentage of feed water accounted for at cut-off, low pressure cylinder,	"	81.2	71.5
19.	Percentage of cylinder condensation and leakage, high pressure cylinder,	"	20.	11.4
20.	Percentage of cylinder condensation and leakage, low pressure cylinder,	"	18.8	28.5
21.	Percentage of steam condensed in reheating pipes,	"	10.3	0.

The quantities given for Test 3 A in lines 11, 12, 19 and 20, include the steam condensed in the reheating pipes.



difference in the two cases of 58.7 horse power. The difference in the power is also revealed by the appended combined diagrams 3A and 3B, in which, as before, the shaded areas *a*, *b*, *c*, *d*, represent the loss of power in the low pressure cylinder referred to the hyperbolic curve of expansion. The difference between these areas is 28.7 per cent. of the low pressure diagram and 11.8 per cent. of the combined area of both diagrams.



CONCLUSIONS.

The three tests referred to all show the same action with regard to cylinder condensation. There is a great reduction in the condensation within the low pressure cylinder, but, owing to the loss of steam in the reheater itself, the resulting advantage is

practically nothing. That the reheater produces no saving, however, is true only when the steam condensed by the reheating pipes is allowed to go to waste and the heat which it contains is lost. In the first engine there was 4 per cent. of the steam thus condensed; in the second, 8.7 per cent.; and in the third, 10.3 per cent. The temperature of the resulting water, with the high pressures used, is 340 to 350 degrees, Fahrenheit. If we assume now that the temperature of the feed water supplied to the boiler is 125 degrees, each pound of condensed steam thus lost carries away with it over 200 heat units, or, in round numbers, 20 per cent. of the total heat of evaporation. Taking the third engine, this loss represents 20 per cent. of 10.3 per cent., or about 2 per cent. expressed in fuel consumption. Consequently, if the condensed steam from the reheater of this engine were returned to the boiler, there would be a saving of fuel, due to its use, amounting to about 2 per cent. It may be safely concluded, therefore, that, although a reheater produces no saving in steam consumption, it will, if properly applied, secure a slight economy at the coal pile.

Apart from the consideration of fuel economy, there is the important question of the effect of the reheater upon the engine capacity. The tests show, without exception, that with the same power in the high pressure cylinder, the reheater produces a considerable increase in the power of the low pressure cylinder, and to that extent it increases the capacity of the entire engine. In the case of the first engine the increase was 4.6 per cent. of the total power. In the second engine the increase was 6.3 per cent., while in the third it was 11.8 per cent. This means that an engine without reheater must have larger cylinders to do the same work than an engine with reheater; or, if the cylinders are of the same size, there is more reserve power in the engine which is provided with a reheater. This feature of the subject makes the reheater advantageous even if it produces no other gain.

The PRESIDENT. Gentlemen, Mr. BARRUS is ready to answer any questions on this subject of heating and reheating.

Mr. ALBERT A. CARY. With my experience I can say that I heartily endorse all that Mr. BARRUS has said in his paper. There is a gain, and it is desirable to use a reheater between the cylinders of a compound engine. Many manufacturers who are too busy to go into the details of such matters simply make inquiries concerning feed water consumption and there their investigation stops. Mr. BARRUS has pointed to other sources of gain, and it is well worth while to give this matter consideration.

I notice in some of the tables given by Mr. BARRUS there is an apparent discrepancy in his accounting for the gain in power, but looking a little further I found his statements all right. For instance, in table 1 we find the weight of feed water consumed per indicated horse power apparently the same with the reheater on and with the reheater off, and the same is true in table 2 and table 3. Then by looking at item 10 in table 1, "Indicated horse power developed by whole engine," we find that with the reheater off there is 33.4 less total horse power developed by the engine than with the reheater on. Turning to table 2 we find the reverse to be the case — that with the reheater off there is apparently more indicated horse power developed by the engine, (viz.—624.1 horse power), while with the reheater on, 601.9 horse power is developed, which is less by 22.2 horse power. But by running your eye down these columns and taking items 12, 13 and 14, you will see that the engine was cutting off earlier in the stroke, whereas if the engine had extended its point of cut-off the same with reheater on as with reheater off, this apparent discrepancy would not be shown in these tables. In table 2, the weight of steam accounted for by indicator at cut-off, high pressure cylinder, is 1.25 pounds less with the reheater on than with the reheater off, and on account of the later point cut-off there is 10 per cent more steam supplied to the engine, which would certainly do more work. But in table 3 we find with the feed

water consumption per horse power practically the same, the total power developed by the engine practically the same, but in this case we find that the cut-off in the cylinder with the reheater on is earlier than with the reheater off, and the weight of steam accounted for by the indicator at the cut-off in the high pressure cylinder is about 10 per cent less, but nevertheless practically the same total indicated horse power is developed with the engine. I merely mention these facts thinking that criticism might be made without proper reference to the other items which should be noted.

The PRESIDENT. Any further remarks? If not, we will proceed with the next papers on the programme, Stop Motion for Engines, and Steam trap, Mr. THOMAS HENRY SMITH, Jamestown, New York.

STOP MOTION FOR ENGINES.
STEAM TRAP.

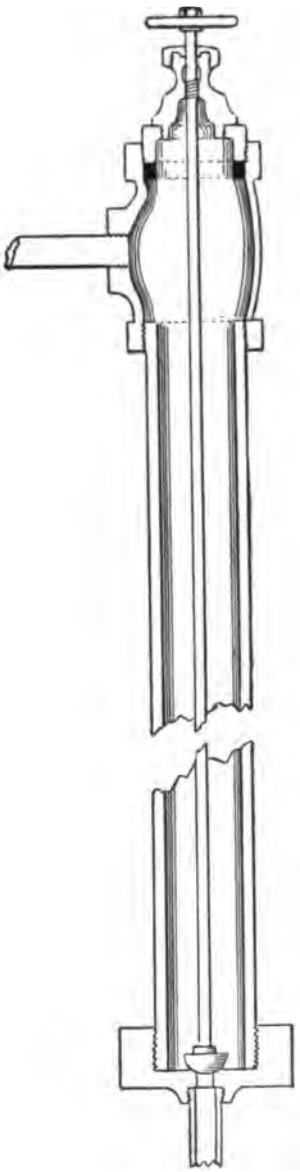
THOMAS HENRY SMITH, Jamestown, N. Y.

Mr. President, members of the Association: I feel as if I were appearing under false pretences this morning with regard to the little talk which I shall give on these matters. I told Mr. WOODBURY at the last meeting that I had a steam trap and a stop motion for engines, both home-made affairs, and I did not know whether an explanation of them would be of any use to the Association or not; and he has put it on the programme, Steam Trap, and Stop Motion for Engines, as if I were going to give a detailed paper on those important subjects, whereas the things I am to describe are home-made and scarcely important enough for your notice. I did not think it worth while to write a paper on the subject, and I wrote Mr. WOODBURY and asked to be excused, but he would not let me off, and here I am.

The importance of steam traps is very great, as we all know, and there are not many appliances on the market which do the work properly. I have had several steam traps for small installations and they get to leaking steam in a little time and there is a great deal of trouble with their passing steam instead of water. The thing I shall show you this morning is an affair I have made, and it seems to act pretty well under the circumstances.

It consists of three feet of two-inch pipe, with a cap on the bottom and a cap on the top, and the stem and gland of a $\frac{1}{4}$ inch valve inserted in the top. That stem is attached to a brass rod $\frac{5}{16}$ inch

* For further reference on this subject see Transactions, Vol. 62, p. 167, HERBERT L. PRATT, Steam Trap.



STEAM TRAP.

dia. On the bottom of the rod is a little hemispherical piece of Jenkin's packing, which is sufficiently hard to resist the action of steam. If you get anything softer than this the steam will melt it away. The ratio of expansion of brass and iron is practically as three is to two; that is, you will have three points of expansion in brass to two in iron. Steam at 50 pounds pressure contains 297 degrees of temperature. Taking 200 degrees as the difference between the inlet steam and the outlet water, a 30-inch trap gives nearly $\frac{1}{32}$ inch in expansion, which is sufficient to drain the trap.

I have noticed that this trap has one advantage — the trap is open when it is empty. That should be the case with all traps, so that when the steam is turned on the water will drain out of the pipes, and the pipes can also drain themselves after the steam is turned off. Turn the steam on, and the water will come out of the half-inch pipe and fill the pipe at at a low pressure. As soon as the steam begins to come the rod will close the valve entirely. After that it will open itself slightly and allow the water to trickle out in a hot stream.

One advantage is that with this little valve arrangement at the top

you can set it as you want it. If you want more steam through the pipe, raise up the valve; if you want less, screw the valve down. That is all there is about it. Anybody can make it; there is no patent on it. You can fit it up yourselves. It costs very little and it seems to me about as effective as anything I have seen.

The diameter of the ball or hemisphere is $1\frac{1}{8}$ inches; the inlet pipe, $\frac{3}{4}$ inch; the diameter of the brass rod, $\frac{5}{16}$ inch.

Put a brass bushing at the bottom, and dish it well, so that the bottom of the ball fits into the bushing. The pressure of the steam forces the ball into the seat. It has to have some elasticity to make it tight. With a Jenkins' valve there is a certain amount of yielding when you screw it up, and it makes the valve tight. This acts the same way.

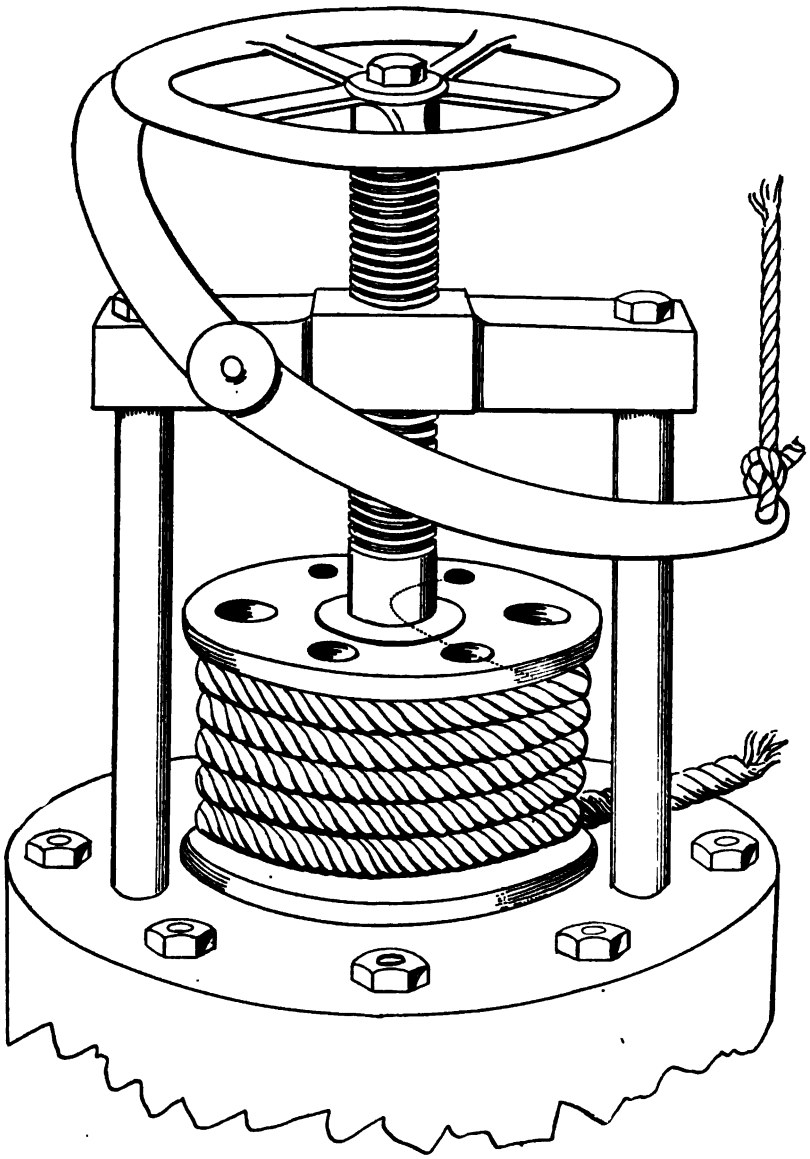
I think that is about all there is in it. If there are any questions to ask I will be glad to reply.

The PRESIDENT. Perhaps, Mr. SMITH, it would be well to go on with the stop motion paper and then they can attack you on both subjects.

STOP MOTION FOR ENGINES.

Mr. THOMAS HENRY SMITH. Here is a stop motion for engines. This is a home-made affair, too, also the drawing.

The use of a stop motion is very important in all manufacturing establishments. If an accident happens in a mill and anybody gets caught, or if a belt laps, or a shaft breaks, you want to be able to stop the machinery quickly without running to the engine house to inform the engineer. Some time ago I got up this device which is applied to the stop valve. I prefer it on the stop valve, because the stop valve shuts tight. A lever is pivoted on a pin inserted in the bridge of the stop valve. The hand-wheel has a V-shaped notch about a quarter of an inch deep on its edge, into which this lever fits. A $\frac{1}{4}$ inch cord is attached to the other end of this lever. On the stem of the valve a flanged pulley is fastened, around which is wound a $\frac{5}{8}$ inch rope, which rope can be carried in the engine room



STOP MOTION FOR ENGINES.

to any convenient place and a weight attached to it. The weight is heavy enough to shut the stop valve instantly as soon as the wheel is released. The other rope (the ¼ inch) is carried into the mill and you can carry it where you like to any required place or places. It can be carried best on wire screw eyes, which are the cheapest and easiest arranged; the rope cannot get tangled up or slip off. You do not want to use a pulley, for fear the rope will slip down and bind between the pulley and the fork. A great many pulleys are made, so there is more room between the sides of the pulley and the fork than the diameter of the rope, and the rope is liable to slip off the pulley and bind between the fork and the pulley. By running the rope through wire eyes a ¼ inch rope can be carried 150 feet or any required distance along side the walls or overhead to the different parts of the mill. If anything happens in any part of the mill, pull the rope, and the valve is shut at once. It whirls around with very great speed, because this weight attached to the ⅝ rope shuts the valve instantly.

The advantages of this over an electric stop motion are, first, that it does not cost much, you can rig it up yourselves; next, an electric stop motion needs a great deal of care, it is all right if properly taken care of, but it requires watching all the time. If the battery runs down or the wire gets broken or the contact impaired it will not work. With this apparatus, however, the engineer practically tests it every time he stops or starts the engine. Whenever he starts it he has to open that valve against the weight and wind it up, and if the weight rope breaks he knows all about it, thus it is tested constantly. You may also carry the stop rope in the engine house where it may easily be reached by the engineer, so that if he has to stop the engine he may do so without going into the engine room. Sometimes an engine runs away and it is dangerous to approach the throttle. With this arrangement, the rope can be reached without going into the room at all. One does not need to take hold of the rope, even; I have it arranged so that one can strike it with his hand and stop the engine.

I think there is nothing about that but anybody can understand. It may be of some use to some small concerns who want to fit up a thing of that sort.

The PRESIDENT. Gentlemen, I think such informal papers or talks on practical ideas are really of much importance to the Association. We ought to have more of them. All of us are apt to have in our works all sorts and kinds of jimcracks, some of them good, some of them bad, some of them indifferent, and I think we ought to be a little more generous, perhaps, here in the Association and give fellow members the benefit of them. You can accept such ideas or not, as you see fit; it certainly does us a great deal of good to have them exploited in this way.

Are there any questions to be asked Mr. SMITH?

ALRERT A. CARY. Mr. SMITH shows no gland in his drawing to provide for packing the valve stem. How is this valve stem packed?

Mr. THOMAS HENRY SMITH. Mr. President, that drawing is a little bit out of proportion; the pulley is really high enough up the stem to allow the gland to be packed. The man who drew it was not familiar with the necessity of packing the stem.

Mr. JOSEPH MERRIAM. I will ask the gentlemen what the effect of the use of that would be on the seat of his valve?

Mr. THOMAS HENRY SMITH. It does not affect the seat of the valve at all, because it is only used in emergencies, the valve being opened and closed by hand in the usual way at all other times.

Mr. JOSEPH MERRIAM. That is just the point I wanted to

bring out. I have seen an electrical stop of a similar nature where it was used constantly, and the difficulty was on a valve closed by a spring that it came down too suddenly, without the judgment which you would exercise in shutting off by hand, and it was difficult to get a valve seat that would stand constant use.

Mr. THOMAS HENRY SMITH. We do not use that except in emergencies.

Mr. ALBERT A. CARY. This point is an important one. I have had a considerable experience with engine stops and have had occasion to test them, and especially, stops of similar design to the one submitted by Mr. SMITH.

It may be permissible to speak here of some of the difficulties experienced with such apparatus and to illustrate my remarks, I will call attention to the drawing I have made on the board (See Figure 1) which presents a top view, a side view, an end view, as well as a sectional view of an engine stop which is operated by a falling weight in a similar manner to the one presented by Mr. SMITH.

By this drawing you will see that the controlling mechanism of the engine stop is enclosed in a case, which case is placed at a short distance from the throttle valve admitting steam to the engine cylinder.

The engine stop has a central shaft extending from one end of the casing and on this extended portion of the shaft is mounted a drum or flanged pulley, around which is wound a small steel rope, the outer end of this rope being carried over small pulleys secured overhead to the ceiling, and on the end of this rope is attached a weight. With this arrangement, the central shaft of the engine stop would revolve were the attached weight free to fall, but an engaged pawl and ratchet (located in the interior of the casing) prevents such turning from taking place until after the pawl is withdrawn from a tooth of this ratchet, (which ratchet wheel is keyed to the shaft of the engine stop).

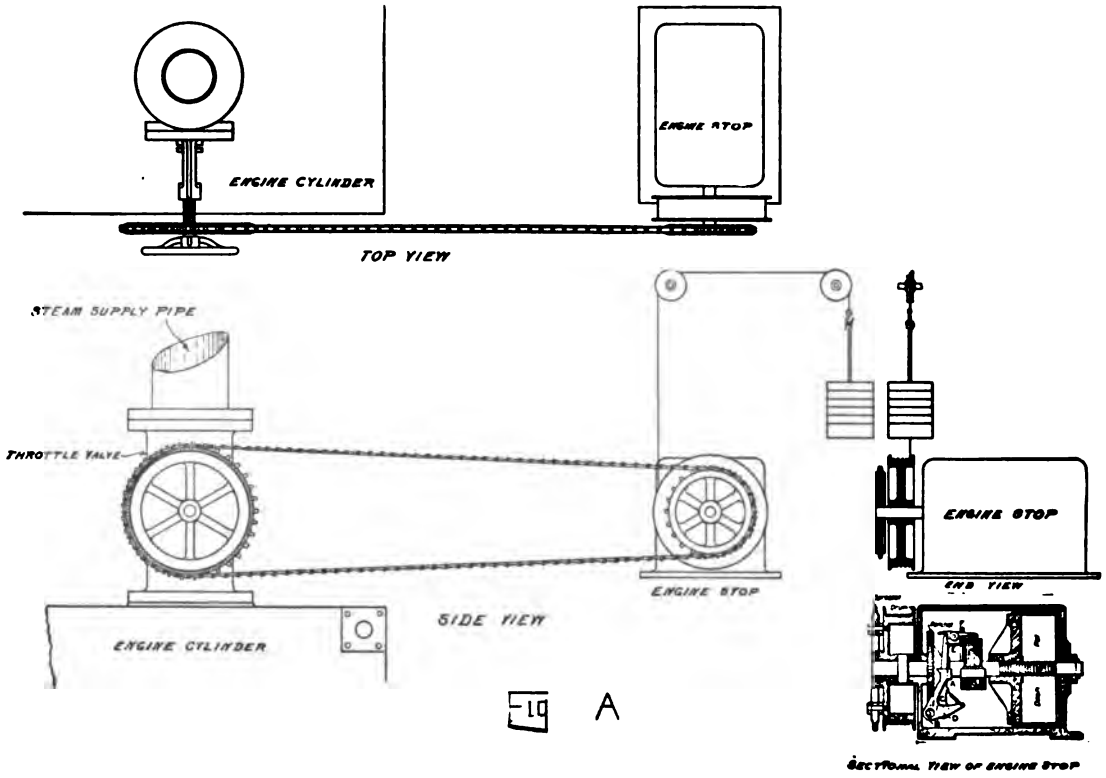

ENGINE CYLINDER
ENGINE STOP
TOP VIEW
STEAM SUPPLY PIPE
THROTTLE VALVE
ENGINE STOP
SIDE VIEW
ENGINE CYLINDER
ENGINE STOP
END VIEW
SECTIONAL VIEW OF ENGINE STOP
FIG A

FIGURE 1.

The pawl may be quickly disengaged by either moving a lever placed outside of the casing or else by sending an electric circuit through the coils of the magnet shown in the sectional view.

When this electric current passes through the magnet, the magnet attracts and moves down the outer end of the trigger *F* which in turn trips the attached spring mechanism, which finally withdraws the pawl from its tooth in the ratchet wheel and then the weight, freed from its restraint, falls and thus causes the rope to revolve the shaft of the engine stop.

Secured to this same revolving shaft will be seen a sprocket wheel which acts as a driver, while a second (driven) sprocket wheel is firmly secured to the valve stem, immediately behind the hand wheel (used to open and shut the valve). A sprocket chain connects these two sprocket wheels, so that when the wheel on the engine stop revolves it, at the same time, revolves the valve stem. By this arrangement, when the weight falls, the valve is closed by such turning action, and when we wish to open the valve to admit steam to the cylinder, we first move the lever on the engine stop, thereby engaging the pawl in the ratchet wheel, (which prevents the weight from falling) and then we turn the hand wheel of the throttle valve the same as is ordinarily done when the valve is to be opened. Of course, as we turn this hand wheel and open the valve, we, at the same time, wind the weighted rope up on its drum (forming a part of the engine stop.)

Now that I have described the operation of this form of engine stop, I will speak of a trouble which has at times proved fatal to its positive and certain operation. The valve stem, of course, has to be packed to prevent the steam from blowing through the opening provided for it, and we find two kinds of packing used in the gland provided to receive the packing: — First, there is a metallic packing, which gives the least trouble when used with this form of engine stop, and then there is what is commonly termed "soft packing," such as hemp, asbestos, rope, etc. When such soft packings are first applied, there is

little trouble in keeping a tight joint, but as this packing wears, we tighten up the nuts on our gland and compress it more solidly, until finally we have a hard, compact mass hugging tightly around our valve stem, which, on account of friction offers considerable resistance to its movement, and heavier weights then become necessary to operate the closure of this valve.

If we originally place sufficient weight on the end of our operating rope, (which turns the engine stop) to provide for such tightening of packing in the stuffing box, it will require so *much* power to turn the hand wheel of our valve stem and open the valve as to make the application of this form of stop decidedly objectionable, so it is always the practice to apply as little weight as we can so as to reduce as much as possible the labor required for opening the valve.

If, after this light weight is adjusted, we tighten up our gland nuts (to prevent leakage of steam) we are apt to make our stop inoperative, and as such a device is supposed to be *always* ready to act in cases of emergency, the end sought for, when we apply an engine stop, is thus defeated.

In all engine stops of this description, there should be provided some arrangement for cushioning the blow which occurs when the valve is sent down on its seat rapidly, or with a constantly increasing velocity, due to the falling of an unrestrained weight; otherwise, if not cushioned, the valve and its seat will soon become battered and a serious leakage of steam, through it, will follow.

You will see in the sectional view of this device, that such an arrangement has been provided in the form of a dash pot.

The inner end of the central shaft of this engine stop has a screw thread cut upon it which is fitted into the center of a piston, which piston virtually forms a nut in which this screw thread works.

As the shaft of the engine stop revolves in the direction which will cause the valve to close, the piston of this dash pot is rapidly moved (by means of the screw) into its cylinder where it

compresses the air held there, and the opposition to such motion offered by this compressed air, prevents the too rapid closing of the valve, and thereby protecting it from a damaging blow, which would occcur if the falling weight were allowed to operate the valve without restraint.

Those familiar with the subject will recall the fact that there is a great difference in the ease of operating the throttle valves of engines. Some of these valves are opened and closed with ease, while the hand wheels of other throttles valves are turned with great difficulty.

In the latter case, where considerable power is required to manipulate throttle valves, the form of engine stop just described should not be applied, as it would require such a heavy weight to close the valve, that an almost prohibitive amount of power is required when we desire to open our valve (and at the same time, lift the weight). Such fault is, of course, due to either a badly designed, a poorly constructed, or else a damaged valve. In some cases it is possible to correct the trouble causing the difficult operation of such a valve, by ordinary machine shop methods, but I have seen cases where the only correction for such trouble is the substitution of a new valve complete.

If one is careful to observe such matters, they may be surprised to find so large a number of poor throttle valves in existence, as I have.

Now that I have offered some serious objections to this form of stop, I will describe another engine stop which does not include these difficulties and by referring to Figure 2, you will see a full side view of this apparatus and at the right will be seen an enlarged detailed sectional view of its operating parts.

This engine stop is made to form a part of the attachments to a fly ball governer of a Corliss Engine (other arrangements being made for other types of engines which I will not consider here).

It is generally well known that by raising the balls of a governer of a Corliss Engine, we can cause the blades of the steam

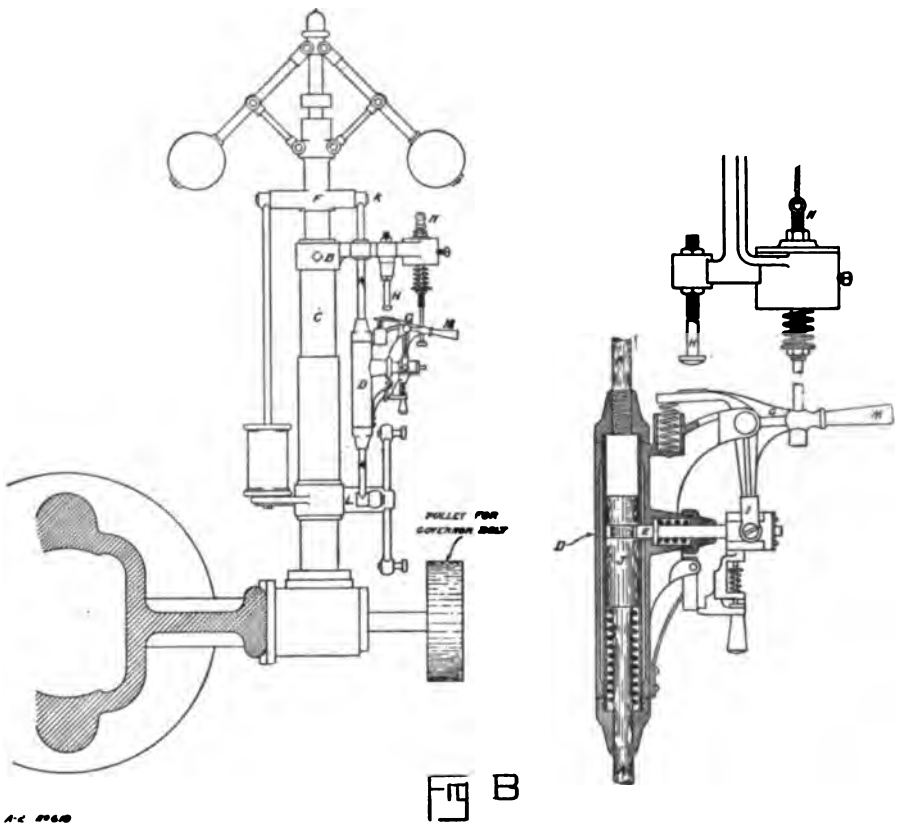


FIGURE 2.

admission valves to cover their ports completely, so as to cut off entirely the admission of steam to the cylinder.

Advantage is taken of this fact in this form of engine stop, which accomplishes this same end: that is, causing the steam admission valves to cut off the supply of steam to the cylinder of the engine when the stop is operated.

The only changes necessary to apply this stop to a Corliss Engine is to cut the main side rod *A-A* of the governer, and apply the bracket *B* to the governer post *C*.

A cylinder, *D*, is inserted along the length of the side rod *A-A*, and so adjusted, when the apparatus is in operating condition, that the length of the side rod *A-A* is identically the same as it would be if the stop were not applied. When thus set, the side rod is held rigidly by a locking device (See *E* in sectional view) so that this length cannot vary during the ordinary working of the engine.

Thus the regular working of the engine is not in any way interferred with, the governer performing its functions the same as its designers originally intended.

Now let us suppose the engine tends to run away. As its speed increases, the balls of the governer are thrown out, revolving in a larger circle. This causes the links attacked to the governer arms to raise the sleeve *F* to which the side rod *A* is attached and, of course, the cylinder *D* is also raised at the same time. As this cylinder continues to rise, it finanly carries the lever *G* upward and against the stationary pin *H*, which pin depresses the inner end of the lever G and such depression causes the lower arm of this lever (See *I*) to move outward (away from the side rod) and such movement of *I* pulls the latch *E* out of its recess in the piston *J* which is enclosed in the cylinder *D*. As soon as this piston is no longer restrained by the latch *E*, the spring beneath it in the cylinder *D* causes the piston to be suddenly projected upward in the cylinder *D* and when this piston *J* occupies this new position, of course the length of the side rod between *K* and *L* becomes shortened. This shortening of the side rod acts exactly the same as though the governer balls were lifted to their highest position, and the steam admission valves are thus suddenly thrown across their ports, and no more steam can enter the cylinder of the engine, which action accomplishes identically the same effect that would be accomplished by closing the throttle valve.

This engine stop has a further attachment which causes the latch to trip when the governer belt breaks, thus protecting the engine still further in this way.

To operate this stop by hand, the end of the trip lever *G* is

provided with a handle *M*. By lifting this handle, the latch *E* will again be withdrawn as has just been described.

To operate this stop from any floor of the building, a rope is attached to the plunger *N* and carried upward to the roof of the building and so arranged that by pulling this rope upwards on any floor, the same effect will be produced as is accomplished by lifting upward the handle *M* as I have just described.

An electrical attachment is also furnished with this apparatus which will cause it to operate by pressing an electric button placed anywhere desired.

Concerning the subject of steam traps, which Mr. SMITH has presented to us, I would say that this is a matter of great interest to most of us. We are certainly looking for good, simple steam traps, and doubtless you have heard (as I have) many steam users state that there is no such efficient apparatus in existence. I do not mean to say that I agree with such an unqualified statement.

The form of apparatus presented by Mr. SMITH would be classified under the heading of "Expansion Steam Traps," which class of traps is the simplest of all made.

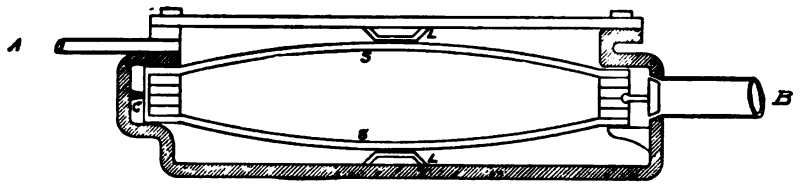


FIGURE 3.

I have shown in Figure 3 a very good form of this class of trap which is by no means new.

The steam enters the box like casing at *A* and its water of condensation is discharged through the outlet at *B*. The casing is made of cast iron which encloses two flat springs *S-S* made of brass or bronze. As the hot steam enters the trap, it warms those springs, causing them to expand. As the springs are prevented from spreading apart (up and down) by the lugs *L-L*;

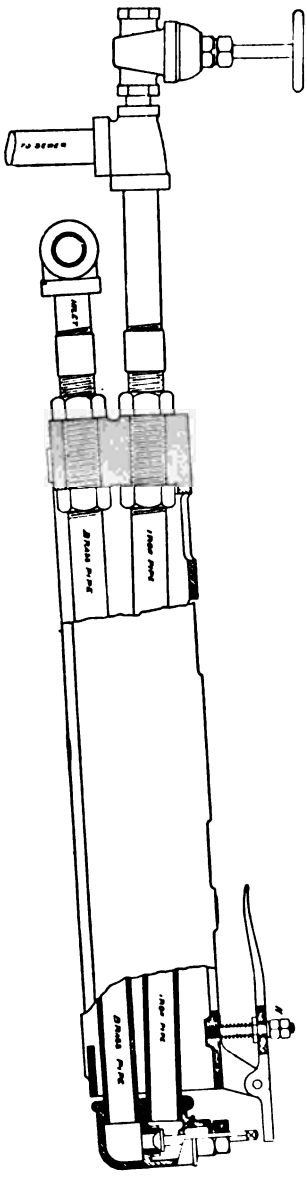


FIGURE 4.

and as the stop *C* prevents their moving towards the left, their entire motion due to expansion, must be in the direction of the outlet *B*. Such movement of course presses the outlet valve into its seat, so that no steam can escape.

Water soon becomes collected in the body of this trap, and as it cools, the springs contract, opening the outlet valve and allowing the water to escape, then the steam follows the water into the trap and, heating the springs, cause the valve to close again, and thus these successive operations continue, the water passing out of the trap while the steam is retained.

Another form of expansion trap, probably more familiar to those here, is shown in Figure 4. This consists of a long cast iron casing enclosing two pipes, one being made of wrought iron and the other of brass.

The steam enters the left end of the lower (brass) pipe which is rigidly secured at the left end of the cast iron casing. The upper (or wrough iron) pipe is also rigidly secured just above the brass pipe, in the cast iron casing.

As brass expands, when heated more than wrought iron, we find that when the hot steam enters the brass pipe of this trap, the special fitting or valve box at the left hand end of these pipes is lifted upward bodily,

causing the projecting valve stem to strike against the projecting lever placed over this valve stem which contact holds the valve down tightly upon its seat, and prevents the steam from escaping through the iron pipe to its point of discharge.

The brass pipe soon fills with water which cools, and contracts this pipe, causing the valve box to drop down, thus allowing the water (which is under pressure) to raise the valve and escape, but the moment the steam follows this water into the brass pipe, expansion takes place, the valve box is raised, and the valve tightly closed against the escape of the steam.

An excellent feature in this style of trap is the easy facilities provided for testing and adjusting it. By opening the gate valve, placed at the extreme left end of this trap, we can soon decide, by seeing what is blown out of this opening, whether the trap is passing steam or not and thereby causing a waste. Should we discover a discharge of steam, we can easily adjust the controlling nuts *N* which regulates the position of the lever (so as to close the valve earlier) and thereby we can regulate the trap so that no steam will blow through. Thus we can most easily test and adjust this trap so as to obtain the most desirable results.

When this trap is in operation, should we wish to blow steam through it to clear it of any contained impurities, we have merely to open the left hand valve, and press down the inner end of the controlling lever, by which means we can blow the steam through as long or short a time as we wish.

The PRESIDENT. It is clear that Mr. SMITH makes a strong point of the fact that his device can be home-made by any little plant, if I understand it.

We will proceed to the reading of the next paper, Smoke and the Determination of its Density, by Mr. ALBERT A. CARY.

Mr. ALBERT A. CARY. Mr. President and Gentlemen: Some time ago I read in one of the daily papers which is noted for its varicity a conversation between a lady from the East and

Chicago lady. The Chicago lady had been visiting her Eastern friend and the Eastern lady was returning the visit. The Chicago lady turned to her Eastern friend during this conversation and asked if she could tell her who was the originator of the phrase, "Cleanliness is next to godliness." The Eastern lady thought for a while and finally said that she could not remember, but she was sure that if he had lived in Chicago the phrase would stand instead, "Cleanliness is next to impossible." [Laughter.]

This is too common a view taken in smoky cities concerning their smoky chimneys. Cleanliness, as far as such smoke is concerned, is not next to impossible, and I have never yet seen a plant where, with proper co-operation from the owner and with a moderate expenditure of money, the plant could not be made smokeless, irrespective of the kind of coal burned there.

*SMOKE AND THE DETERMINATION OF ITS DENSITY.

ALBERT A. CARY, 95 Liberty Street, New York.

R. W. EMERSON gave a definition of dirt as "matter in the wrong place" and were we asked to define smoke, it would be difficult to find a definition which would appeal to us stronger than the one just given for dirt, as where could matter be more out of place than these black, greasy flecks we find floating in the atmosphere we breath and live in, which are so unnecessarily delivered from certain chimneys connected in every case to badly designed or improperly operated furnaces.

To those who are somewhat acquainted with furnace practice but have given the smoke matter little attention, smoke has generally been considered as small flecks of unconsumed carbon floating in a cloud of steam, which steam has been produced during the process of combustion from the hydrogen contained in the fuel and from the water evaporated from the moisture originally contained in both fuel and air used in the furnace.

Such a conception may be ample for ordinary considerations, but for more careful investigations it is necessary for us to have a more accurate knowledge of the subject, and with this end in view the author has prepared the first part of this paper, which will, for the sake of simplicity deal only with bituminous coals.

If a fleck of soot from a factory chimney strikes our hand, we may, perhaps *blow* it off, but in case we attempt to rub it off with the other hand, we find a black greasy streak or smooch

* For further references on this subject see Transactions as follows: Vol. 53, p. 69, EDWARD ATKINSON, Smoke Consumption; Vol. 67, p. 259, OSCAR ELSAS, Methods of Diminishing Smoke from Mill Chimneys; Vol. 70, p. 218, O. C. WOOLSON, Possible Additional Economies at the Steam End of the Mill; Vol. 73, p. 303, ALBERT A. CARY, Mechanical Stokers.

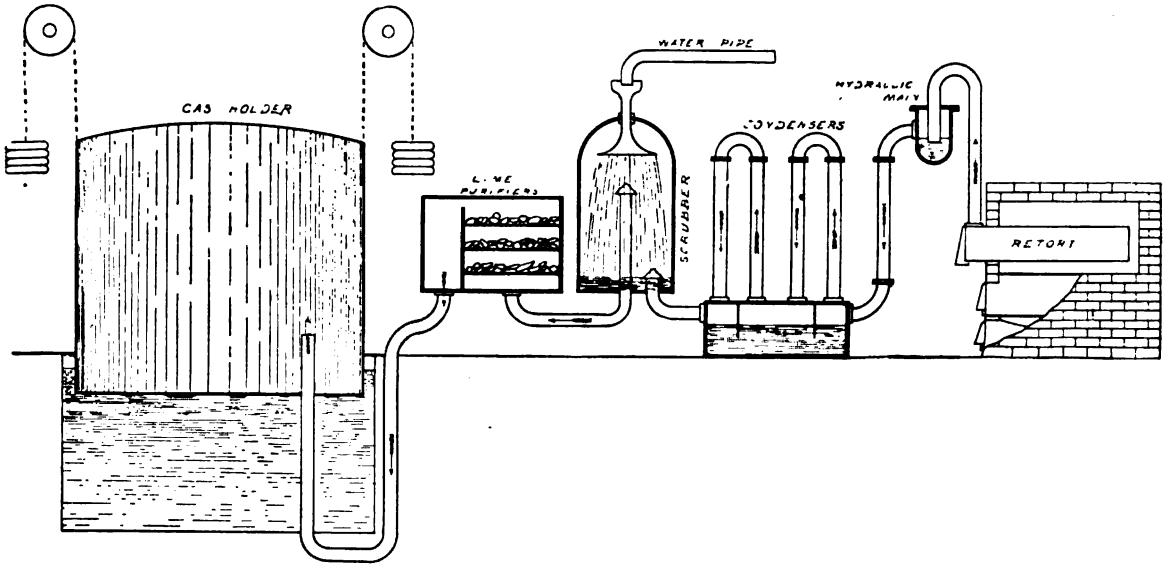


FIGURE 1.
Apparatus for Manufacturing Coal Gas.

left behind, and one needing hard rubbing with soap and water to remove it.

A fleck of pure carbon will not stick thus tenaciously and it has not such a peculiar greasy feeling, so we must look for something else besides pure carbon in our soot.

Probably the simplest way to study the formation and composition of these small greasy flecks of "dirt," is to consider first the method employed in the manufacture of pure coal gas and the resulting products derived from it.

To simplify my description of the production of coal gas I offer the illustration shown in Figure 1, which shows the apparatus used in its manufacture in a diagramatic form.

In the gas house we find specially designed furnaces, containing a number of long ⊍ shaped retorts, into which the bituminous coal, used in making the gas, is placed. (The illustration shows but one of these retorts in the furnace.)

One end of each of these retorts is closed, while the other end (also closed) has an outlet *A*, termed the ascension pipe.

All of these several ascension pipes from one furnace are united together into one common header, out of which header leads a bent pipe (termed the dip pipe). The outer end of this dip pipe plunges downward under the surface of water contained in a long iron vessel, called the hydraulic main. The illustration shows a cross sectional view of this hydraulic main.

Before proceeding further with the description of this apparatus, let us open a charging door at the end of the gas retort and introduce a quantity of bituminous coal, which may have the following chemical analysis:

	Per cent.
Carbon,	82.32
Hydrogen,	5.41
Nitrogen,	1.35
Oxygen,	5.69
Sulphur,	1.34
Ash,	3.89
Total,	100.00

We then close our charging door, sealing it hermetically and build a fire upon the grate beneath the retort, and its heat will first drive off the volatile gases contained in the retorted coal without producing combustion (due to the absence of air).

After these gases have been thus driven off, we open our retort and find remaining a coke which is a little over 60 per cent. in weight of the original coal.

This coke consists of practically pure carbon, with the ash or non-combustible matter contained in the original coal.

We have now distilled off somewhat less than 40 per cent. of the original weight of the coal as gas and vapor, having an analysis approximately as follows:

	Per cent.
Carbon,	25.54
Hydrogen,	5.41
Nitrogen,	1.35
Oxygen,	5.69
Sulphur,	1.34

The gaseous and vaporous product distilled from the coal which passes from the submerged dip pipe into the hydraulic main deposits a dirty, black, sticky or greasy substance known as coal tar and it also leaves behind, ammonia water.

We have now found a clue in this tar which points to the reason for finding the atmospheric soot both greasy and sticky. It would be difficult to imagine any more persistent dirt (from a detergent standpoint) than exists in this tar, but its redeeming feature is found in the fact that it contains a large number of most valuable products, the beautiful analine colors being one derived from this source.

Analysis of this coal tar gives approximately the following composition:

	Per cent.
Carbon,	77.53
Hydrogen,	6.33
Nitrogen,	1.03
Oxygen,	14.50
Sulphur,	0.61
Total,	100.00

These elements in the tar are built up into about 140 different constituents, traces of which can be identified by the chemist. It is found to contain benzole, naptha, napthaline, anthracene, carbolic acid and pitch, which may be extracted by processes of partial distillation.

After leaving the hydraulic main, the remaining gas passes by the pipe *B* through a series of vertical pipes called a condenser and is considerably lowered in temperature. The gas after leaving the hydraulic main is by no means freed from all contamination, as we find in it a certain amount of vapor, sulphuretted hydrogen and carbon disulphide. When cooled in the condenser, it drops the last traces of liquid impurities and then, to remove the sulphur compounds it is passed into the bottom of a scrubber, where it is made to rise through a shower of clean sprayed water in which all the compounds soluable in water are taken up, and then it passes into the lime purifier, consisting of a large and tight vessel containing a number of trays filled with slaked lime, and as the gas comes in contact with a large surface of this reagent, its remaining sulphur impurities are removed. The gas, now having passed through its entire purifying process, passes on to the gas holder ready for use. The average composition of the purified coal gas will be:

	Per cent.
Hydrogen,	47.99
Saturated hydrocarbons,	37.64
Unsaturated "	4.41
Carbon monoxide,	3.75
Carbon dioxide,	nil
Oxygen,	0.26
Nitrogen,	5.95
Total,	100.00

The approximate proportion in which the products are obtained from a long ton of gas coal is as follows:

	Pounds.	Per cent.
10,000 cubic feet of gas,	380	17.0
10 gallons of tar,	115	5.1
Gas liquor (condensed from the gas alone),	177	7.9
Coke,	1,568	70.0
	2,240	100.0

The above described actions in the manufacture of coal gas, taking place as they do at a temperature of about 1800 degrees Fahrenheit, and under conditions which result in heating the gases and vapors after they are liberated from the coal as they pass through the upper portions of the retort, are not dissimilar to the decomposition of a very thin layer of bituminous coal spread on the surface of an incandescent firebed, but as the temperature utilized to distill off these gases and vapors is lowered, the smaller will be the volume of gas evolved, following which rapid changes will take place in the composition and quantity of tarry vapors distilled off.

Prof. VIVIAN LEWES, of the Royal Naval College at Greenwich, Eng., has investigated the smoke problem from a chemical standpoint very thoroughly, and as his words fit into this stage of our discussion most aptly I cannot do better than quote from a paper on this subject written by him in 1895. (See English Gas World.)

"In placing a quantity of bituminous coal on a fire the decompositions will vary with temperature in every part of the charge, and an inch away from the live fuel the coal will be distilling off tar vapors rich in paraffine hydrocarbons, and yielding very little gas. Complex as are the changes taking place in the decomposition of the coal itself under the influence of heat, the further actions which take place when the products burn in contact with the air and other gases at the top of the fire are still more so, and are affected by the nature of the products from the coal, the amount of air present, temperature, and the diluting action of the products of combustion from the lower part of the grate. Stated in its simplest form, the hydrocarbons present in the gas and tar vapour reach the air above the fire diluted with

nitrogen, carbon dioxide, carbon monoxide, and water vapour from the combustion in the lower part of the grate, and as soon as they reach the surface of the fuel are met by the rush of cold air drawn in by the chimney draft, the oxygen of which enables the combustible gases and vapors to burn, whilst the nitrogen still further dilutes and retards the actions taking place.

"All flame is caused by the combustion of gaseous matter. When the supporter of combustion is supplied externally to the combustible gas, such a flame is always hollow, and will consist of at least two parts, an outer part in which combustion is taking place, and the interior of the flame, which being cut off from the supporter of combustion by the burning envelope, can obtain no oxygen to carry on the action. In an ordinary flame, such as is used for illuminating purposes, there are generally four distinct parts, but in such a flame as that obtained by the combustion of the gases and vapors escaping at the top of a fire, it will be sufficient to look upon it as consisting of two. The inner portion, although not undergoing combustion, is an active area of chemical change, as under the baking influence of the burning envelope which surrounds it the hydrocarbon gases and vapors are gradually broken down, the most important action being their conversion into the simple hydrocarbon acetylene, which contains 24 parts by weight of carbon combined with 2 parts by weight of hydrogen. In the outer envelope of the flame both the carbon and hydrogen compounds present are being consumed with formation of carbon dioxide, carbon monoxide, and water vapor. But in the flame certain other changes are observable to the eye. The dark inner zone, which we may look upon as a laboratory and gas store of the flame, is summounted by a portion which is brilliantly luminous, and gives the major part of the cheerful fire light. Higher up the flame the luminous portion becomes dull red in color and gives out far less light, and above this again smoke begins to appear in considerable quantities. These gradations in appearance are due to the acetylene formed in the non-luminous core of the flame entering the heated zone of combustion, when the acetylene suddenly

splits up into carbon and hydrocarbon, the latter of which burns and adds to the general heat of the flame, whilst the carbon, raised to incandescence, partly by heat generated during its own formation from acetylene, partly by heat from the flame, and partly by its ultimate combustion, gives out the light. If sufficient oxygen were supplied to complete the action, no smoke would escape from the flame, and a far higher power of radiating light and heat would be produced; but one finds in practice that the diluting influence of the nitrogen and other products from the fire beneath, and the cooling influence of the chimney draft which comes in contact with the flame, so check and hamper the completion of the combustion of the products from the decomposition of the acetylene, that you have the top of the flame cooled to a dull red and the flame finally extinguished before the carbon particles can be consumed, this leading to the sooty smoke which passes up the chimney.

"It must not be inferred from this that the smoke which pollutes our atmosphere is entirely formed in this way. But the black particles of carbon which form the soot in the chimney and the blacks which float in the atmosphere are nearly all thus produced, the remainder of the smoke consisting of undecomposed tarry vapors, and the steam which is abundantly condensed from the water vapor produced as one of the primary products of combustion.

"If we take the smoke from a cigar or from a cigarette and blow it into a thin glass chamber highly illuminated from below by focusing upon it the beams of an electric lantern or lime light, and examine it under a high-power microscope, it presents a most remarkable and wonderful appearance. Such smoke contains no particles of free carbon, but appears to consist of an immense number of little round particles in the wildest condition of commotion and movement, each particle rushing about and never coming in contact with its neighbor. Indeed, it presents as beautiful a picture as one could imagine of the molecular movement with which theorists have endowed matter. On still further examination these little particles prove to be tiny vesi-

cles, the skins of which are formed of condensed vapor and liquids from the burning substances which give rise to them. These vesicles, being filled with gases, are excessively light, and float in the atmosphere until brought forcibly in contact with some surface, which causes them to burst and deposit the liquid film, so setting the contents free.

"The tar vapor which escapes during the distillation of coal, either in the gas maker's retorts or upon an open fire, consists of a mass of vesicles of this character. When the temperature at the top of the fire has been sufficient to ignite the gas escaping from it, they are not formed, and under these conditions only a small portion of the escaping smoke is of this character, the smoke being chiefly carbon particles. When the fuel has been put on in sufficient quantity to cool the top of the fire below the ignition point of the gas, the smoke which escapes consists chiefly of steam and of this tar cloud; whilst all smoke contains dust and ash from the grate.

"It will be seen from this description of the formation of smoke that there are four sets of particles forming it. (1) Carbon particles escaping unconsumed from the burning hydrocarbons, and giving the soot. (2) Tar vapors. (3) Steam. (4) Small particles of dust mechanically carried up by the draught. The proportions in which the four occur in the smoke are entirely dependent upon the condition of the surface of the fire. When the fuel is first put on, tar vapor and steam only escape from the fire below, together with the products of complete and incomplete combustion, amongst which you have carbon monoxide. As the heat works upward through the new fuel, the products of distillation from the coal catch fire and are partially burned, the result being that the deposited carbon or soot, also forms a portion of the smoke, whilst as the fire burns clearer and clearer, and the upper portion becomes incandescent, practically nothing but the products of complete combustion find their way up the chimney."

From this clear description of Prof. LEWES and from the description of the manufacture of pure coal gas we have now

obtained a good idea of how smoke is formed and what its solid, gaseous and vaporous matter may be composed of, which information will be found useful, not only in our consideration of smoke nuisance problems, but also in considering smoke washers and "annihilators" whose inventors and manufacturers claim that considerable returns can be made by utilizing the residum, resulting from their cleansing process.

We will now turn our attention to methods that have been used in determining the density of smoke as it issues from the chimney to enable us to make more or less accurate determinations of the results obtained by any of the smoke suppressing methods used in connection with our furnaces.

Probably the only accurate method for determining the quantity of free carbon, tarry matter and ash or dirt contained in the smoke is to properly withdraw a sample of the escaping products of combustion from the boiler outlet and carefully separate the solid from the gaseous matter, and after noting the internal capacity of the vessel which held the sample of gas with the weight of its solids, we can easily calculate the weight of the solids contained per cubic foot of gas.

This process is a difficult one when properly conducted, and beyond the ability of a man who has not had the careful training of a physist or chemist.

Several methods have been used for directly collecting the soot, etc., on flat metal plates suspended in the path of the escaping products of combustion, some smeared with a sticky substance and others have no specially prepared surfaces, but depending upon the sticky, tarry vapors present to cause the soot to adhere.

Such plates are allowed to remain in place for a definite period of time, and the weight before and after such immersion in these gases is noted, the difference giving the quantity of soot, etc., collected during this period. In other tests of this kind the soot is brushed off the plate by use of a wire brush and weighed separately.

Such tests are only comparative, the plate being placed in the

flue during the test of one set of conditions, and then after cleaning, it is replaced in the flue for the same period of time during the boiler's operation under another set of conditions, and the various results of soot accumulations are finally compared.

The camera is sometimes used in smoke determinations, photographs being taken of the escaping furnace products periodically, and the shades produced in the prints are compared. This is a misleading method for determining the density of smoke, as the position of the camera as regards the sun, the state of cloudiness of the sky, the method of developing and printing all lead to variable results.

The Prussian Smoke Commission of 1894 used a very elaborate method for determining smoke density which, although closely approximating accuracy is too refined for the average observer.

Their apparatus included a photometric instrument (such as is used to determine the candle power of all illuminants). Two openings were made by them on the opposite sides of the boiler flue carrying the soot ladened products of combustion, and the eye placed near one opening observed the appearance of the flame of a standard candle placed behind the opposite opening, and this candle's brightness (*i. e.*, the dulling of its brilliancy) was compared with the flame of an unobscured standard candle according to the usual method of making photometric measurements.

Probably the oldest and most widely used method for determining the density of smoke is by direct observation.

For this purpose the observer takes a position where he can easily watch the smoke issuing from the chimney and in order to describe the results found, he must adopt some standard of density, in order to properly express the various shades of color of the smoke, and he should also note the length of time that each of these shades exist.

It will be readily seen that such a system of observation, made with nothing but the observer's sense of discrimination to help him form an opinion of the smoke's density will lead to ex-

tremely variable results; one man's idea of density differing materially from another's. The writer has known where two or more men have been stationed at different points of observation in order to eliminate the personal equation as much as possible, the results obtained by these separated observers being finally averaged.

Different results are obtained even by any one of such observers when they watch the smoke under different conditions, such as; looking towards or away from the sun; looking against a clear blue sky or against a bright white cloud, or else against a dull dark cloud. It is almost impossible to avoid a comparison between the smoke and its background, so it is well for such an observer to adopt a similar position for all observations (as regards the position of the sun) and also to see that his cloud background is approximately, always the same.

As to a scale of density to enable one to note the condition of the smoke, a number of expressions have been used to form a basis of comparison, but they unfortunately differ widely, and it is to be regretted that engineers have not yet been able to decide on some one definite standard upon which they can all agree which might be adopted for the expression of all smoke density measurements.

One method of expressing smoke's density is to call the densely black opaque smoke, 100 per cent., and when the chimney is issuing an absolutely invisible vapor call it zero per cent. of smoke, and then term the various shades between these two extremes as various percentages of smoke, according to its relative density. This system, although quite clever in its conception, depends too largely upon the varying judgment of different observers and so it is not very satisfactory.

Some have considered simply three degrees of smoke conditions: viz., dense smoke, medium smoke, and no smoke, but this scale is too limited to be of much value.

The English Smoke Abatement Committee of 1895 used four shades in their considerations, which proved fairly satisfactory. These were: dense, No. 3; medium, No. 2; faint, No. 1; and

no smoke, No. 0; noting each condition by their corresponding numbers.

At the Paris Smoke Tests of 1897, five degrees were used, as follows: "very thick smoke," "black smoke," "medium smoke" "slight smoke" and "no smoke." This is the most satisfactory of all scales thus far described.

I have tried to use another scale which was suggested to me containing ten degrees of smoke conditions, but the divisions proved too numerous for easy quick application, and I have found that a scale of five or six degrees will express with sufficient clearness the condition of smoke appearance, and at the same time the differences between these degrees are not too fine definitions to admit of easy and quick determinations.

A number of devices have been used to assist the observer in determining density, these affording an opportunity to compare the smoke with some other shaded object. One of these consists of a number of pieces of "smoked glass" of the same density in color, dropped one after the other into place across the section of a tube. The outer closed end of this tube is provided with a plane mirror set at 45 degrees so as to reflect light from above through the smoked glasses. This tube is placed to one eye, allowing the observer to look through the smoked glasses towards the mirror, while the other eye observes the smoke issuing from the chimney. As one after the other smoked glass is dropped into position a density is obtained similar to that of the smoke. The number of smoked glasses used is then noted to indicate the density of the smoke.

I have heard of a similar device which, instead of interposing successive pieces of smoked glass, uses a triangular prism having a metal top and bottom, the end or base of the triangle also being metal. The two sides of this triangular prism, meeting at the apex, are made of glass. The interior of the prism is filled with water (or alcohol) colored with a black coloring material, and the observer looks through the two glass sides, through the liquid across the prism along lines parallel to the base. As we look through a small depth of liquid, near the apex of the tri-

angle, the interference to the passage of light being small, we see but a faint gray light, while, when looking through the greatest thickness of liquid, near the base of the triangular prism, where the passage of light is greatly interfered with, we find an almost black appearance. The various positions between these two extremes giving us a large variety of intervening shades and by noting the width of the prism opposite our eye when a shade is obtained corresponding to the density of the smoke observed by the other eye, we can find an expression for the smoke's density.

There have been two smoke charts devised to assist observers in determining the density of smoke, one having been originated by Prof. RINGELMAN of Paris, while the second chart, (which is an improvement on the one produced by RINGELMAN,) was originated by the late BRYAN DONKIN of England.

The Ringelman chart can be found reproduced in the transactions of the American Society of Mechanical Engineers in connection with "The Report of the Committee on the Revision of the Society Code of 1885, Relating to a Standard Method of Conducting Boiler Trials"; also in KENT'S "Steam Boiler Economy" and in BRYAN DONKIN'S work on "The Heat Efficiency of Steam Boilers".

This Ringelman chart is composed of six rectangles, the first being perfectly white, while the sixth is entirely black. The four intermediate rectangles contain a series of equidistant lines, drawn parallel to the sides of the rectangles. By hanging this chart between 50 and 100 feet away from the observer, we find that the cross lines blend together, forming a succession of tints, the shading from one tint to the next one being carefully modulated so as to form a definite succession of steps in gray colorings between black and white. By hanging this chart between yourself and the chimney, you can easily compare the different tints presented with the smoke issuing from the chimney and decide which shade in the chart corresponds to that of the smoke. In recording the smoke's density you can write down the corresponding number found on the chart, or in case you wish to

make a finer distinction (supposing you decide that the shade of smoke falls between any two tints), take the smallest number and add a fraction to it, as for example, 3½, 4¼, etc. The number of cross line figures given in this chart are fully adequate for their purpose; any further addition would only lead to confusion, as has already been explained.

I know where this scale has been used on a percentage basis, calling the all white rectangle the zero per cent. of smoke, the next 20 per cent., then 40 per cent., and so on to the black rectangle, which, of course, corresponds to 100 per cent. of smoke. The rule given by Prof. RINGELMAN for constructing this scale is as follows:

No. 0, All white.
" 1, Black lines 1 mm. thick and white spaces of 9 mm.
" 2, " " 2.3 " " 7.7 mm. apart.
" 3, " " 3.7 " " 6.3 " "
" 4, " " 5.5 " " 4.5 " "
" 5, All black.

With a scale constructed according to these directions, the observer will be obliged to place the chart over 60 feet away to obtain a blending of the lines into the desired tints and such a distance is often inconvenient. For that reason the charts produced in the works just referred to are plotted with their dimensions just one-half of those given above, which will allow their use at one-half the distance I have named.

Mr. WILLIAM KENT received from BRYAN DONKIN (shortly before the latter's death) one of DONKIN'S smoke charts, which he has kindly placed at my disposal. This chart will be found reproduced on the folder accompanying this paper (see enclosed folder in which square number 0, represents no smoke; number 1, twenty per cent.; number 2, forty per cent.; number 3, sixty per cent.; number 4, eighty per cent.; and number 5, one hundred per cent. This, it will be seen, like the Ringelman chart, consists of six rectangles, No. 1 being all white while No. 6 is all black, the intervening numbers consisting of a series of flat tints

of gray, ranging by definite steps in coloring from the white to the black.

This Donkin chart can be placed as near the observer as he may desire to place it, which feature entirely overcomes a serious obstacle which so frequently makes the Ringelman chart useless.

When making smoke density determinations it is desirable to note the condition of the smoke at frequent and equal intervals of time. Every half minute has been found a very satisfactory interval. When the test is an important one, not less than two separated observers should make records, with the time of observation carefully noted on their sheets along with the number expressing the shade of the smoke existing at that time; the separate records being finally compared and one checked against the other.

At the same time the above records are being made, some one in the boiler room should note the time of each firing and cleaning and also state the conditions existing at various other recorded times, such as "forcing the boiler", "running light", etc.

If furnace gas analyses are made during the time of these observations, and if the result of these analyses along with all of the other observed results are finally plotted on cross section paper, we will be able to make a careful analysis of existing conditions pertaining to the production of smoke in the plant under consideration, and means for further suppressing the smoke can generally be found by making proper deductions from such plotted diagrams.

A time keeping apparatus to assist in plotting smoke diagrams was used by the smoke observers during the Paris Smoke Tests (conducted in France between 1894 and 1897). This device contained a cylinder driven by clockwork, and around this cylinder is placed a paper on which the record is written (similar in manner to the paper placed on the drum of a steam engine indicator).

The drum of the smoke recording device is turned the same

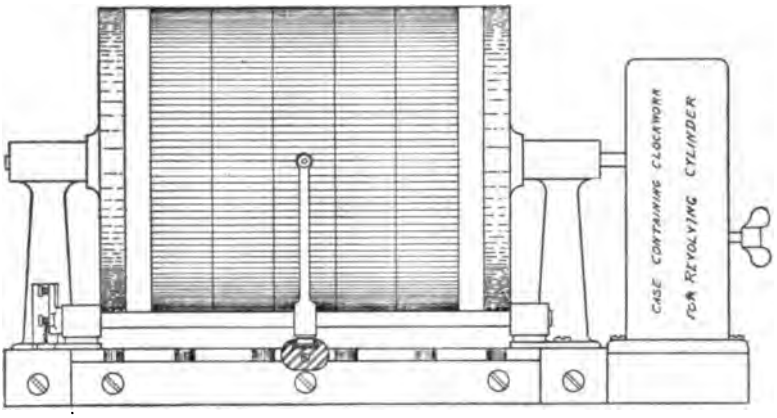


FIGURE 3.

Semi-automatic apparatus for recording smoke density. (Front elevation.)

as the hands of a clock, a given distance around the circumference representing accurately one minute.

The pencil, pressing against this paper on the drum, is moved across the face of the cylinder (parallel to its axis) by the observer, who pulls the slide rod carrying the pencil to its extreme left position when there is "no smoke". This causes the pencil to draw a line around the circumference as the clockwork revolves the cylinder, which line marks its zero position. When "slight smoke" was seen, the observer moved his slide rod one division to the right, which caused the pencil to mark a line around the circumference of the revolving cylinder a definite distance to the right of the zero line.

The slide rod was again moved another division to the right when "medium smoke" appeared, which caused the pencil to trace a new line, double the distance of the last one (for slight smoke) from the zero line.

As "black smoke" appeared, the pencil was again advanced to the right another equal distance, and finally, when "very thick smoke" appeared, the observer pushed the pencil as far to the right as possible, and so the five equidistant circumferential lines represent the five different degrees of smoke adopted

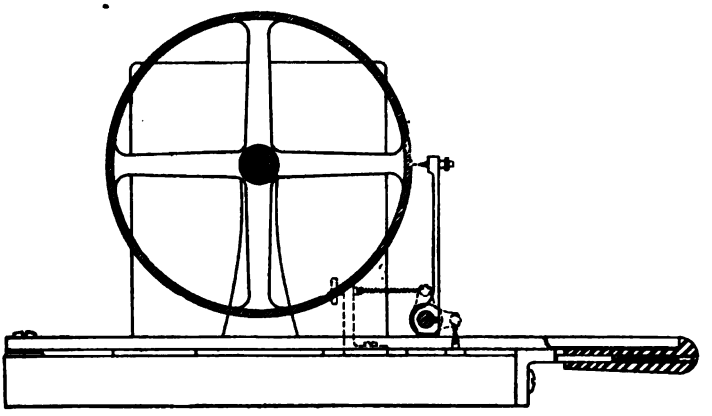


FIGURE 4.

Semi-automatic apparatus for recording smoke density. (Side view.)

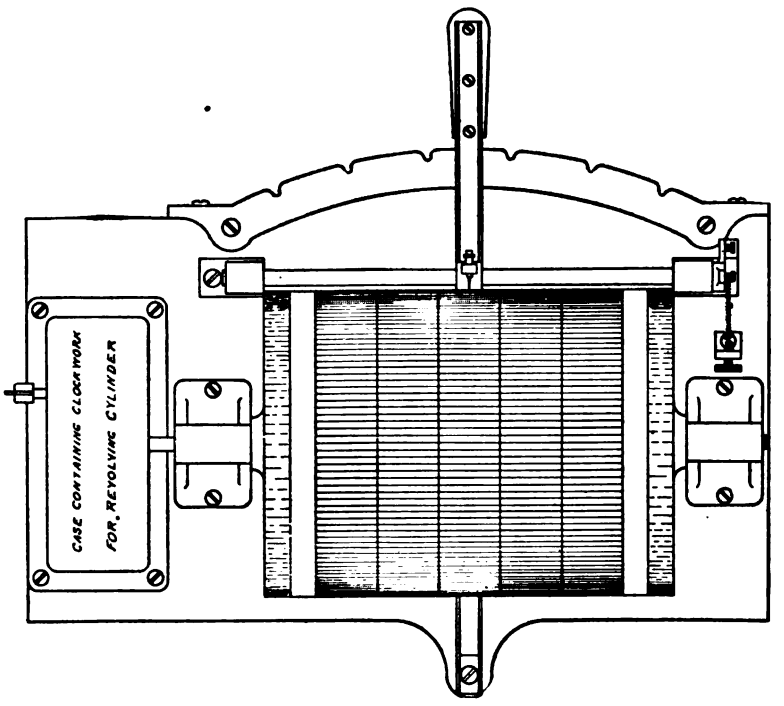


FIGURE 5.

Semi-automatic apparatus for recording smoke density. (Plan view.)

by the Paris Smoke Test Commission, and with the recording cylinder constantly revolving we find our smoke record finally plotted on the paper the same as if we had hand plotted it on cross section paper, calling the ordinates time and the abscissa degrees of smoke density.

An apparatus of this kind devised by the author, which is an improvement on the Paris machine is illustrated here. Figure 3 represents the front elevation, figure 4 the end elevation and figure 5 the plan view of this apparatus. It will be seen that the pencil is moved along the length of the cylinder by means of a pivoted lever, the outer end of which is grasped by the operator's hand. As the lever is moved a spring detent slids easily into (or out of) one notch after the other in the segment on which the outer end of the handle rides, each notch holding the pencil in position on the paper corresponding to the degree of smoke observed.

Since producing this time keeping apparatus the author has devised a further improvement on this machine, which allows the use of a long roll of ruled cross section paper and also reduces the size of the smoke recorder.

The PRESIDENT. As this completes the programme for the morning, the session stands adjourned until two o'clock this afternoon.

FOURTH SESSION.

THURSDAY AFTERNOON, April 23, 1903.

The Association met in Chipman Hall, at 2 P. M., President FISH in the chair.

The PRESIDENT. The first paper on the afternoon's programme is Export Markets for American Goods, Mr. EDWARD N. Vose, of New York City.

*EXPORT MARKETS FOR AMERICAN COTTON GOODS.

EDWARD N. VOSE, Editor *Dun's Review, International Edition*, New York.

The cotton manufacturers of the United States are to-day in a position that is compelling the more thoughtful among them to study the subject of foreign markets more attentively than ever before. Export trade has heretofore been a fad with some, an experiment with others. It will shortly be a necessity, if not for all at least for so large a number as to materially influence the prosperity of all. It is, therefore, vitally important to the leaders of this great industry that they should be in possession of the fullest and most accurate information available regarding every possible opportunity to develop foreign trade. In this connection I desire to call the attention of this Association to the following points: 1st, that no adequate study of the foreign field for American cottons has ever been undertaken by a competent organization; 2nd, the timeliness and importance of such a study just now; 3rd, the scope of such an investigation; and

* For further references on this subject see Transactions as follows: Vol. 20, pp. 15 and 33, EDWARD ATKINSON, Export of Cotton Goods; Vol. 20, p. 57, FREDERICK A. LEIGH, British Exports; Vol. 63, p. 268, Dr. WILLIAM P. WILSON, Movement and Statistics of Cotton Goods; Vol. 63, p. 284, ARTHUR PARKINSON, Manufacture and Export Trade of Cotton Goods; Vol. 63, p. 303, FRANK P. BENNETT, Imports of Cotton Goods; Vol. 64, p. 227, CHRISTOPHER P. BROOKS, Our Export Tiade in Cotton Goods; Vol. 67, p. 96, D. A. TOMPKINS, Export Trade; Vol. 68, p. 89, D. M. THOMPSON, Importance of Export Trade; Vol. 68, p. 176, Dr. WM. P. WILSON, A Critical Moment in the History of Export Trade in Cotton Manufactures; Vol. 70, p. 88, D. M. THOMPSON, Foreign Markets an Imperative Necessity; Vol. 73, p. 357, Dr. WM. P. WILSON, The Export of Cotton Goods.

4th, the peculiar fitness of this organization to accomplish such a work.

The fatal defect of virtually all of the published information regarding foreign markets for American cottons is that it has been prepared by men who possessed little or no knowledge of the manufacture and selling of cotton goods. American consuls are the authors of most of the information issued by the Federal government but those who have made a careful study of the consular reports over an extended period of time agree that they contain little of genuine value regarding this subject except in the way of statistics showing the export and import movements in the cotton goods trade of their respective districts. Such statistics are interesting to the student but of very little practical value to the business man. Do not think that in saying this I am indifferent to the value of the work our consuls are doing or to the increasingly high standard of the service as a whole. On the contrary I desire here to testify my appreciation of the fact, which may have been overlooked by some of you, that under the wise guidance of Secretary Hay the entire diplomatic and consular service is gradually being raised to a higher level of efficiency than has before been known in this country — and that quietly and without any assistance from Congress. On non-technical matters our consular reports were never before so useful, as they have never before been so complete and so promptly published. But the facts that it is essential to know regarding the existing situation in a foreign buying market for cottons are so technical, and the factors that influence the placing of the trade in its present channels and would render its diversion to this country easy or the reverse are so numerous and so hard to ascertain, that only men experienced in this particular branch of trade are really competent to conduct an investigation that can lead to practical results.

Editors are subject to precisely the same criticism. By carefully collecting all the data that is available on this important subject, including the leading foreign government publications and trade newspapers, an editor making a special study of inter-

national trade movements is in possession of a great deal of material of real value. The reports of most of the British consuls and of many of the consuls of Germany, France, Belgium, Austria and some other countries, are very full on the subject of markets for cotton goods. But all of this information, besides relating only indirectly to American goods, is also non-technical and is confined chiefly to the statistical situation. Trade journals are at present highly organized and offer better service than ever before but their function is not to discover new markets, but to chronicle the movements in the markets as they now exist. They are reporters, not guides.

There is one other group of observers who really do know the facts regarding export trade in specific lines of American cotton goods in foreign markets: the export brokers and the limited but growing number of exporting manufacturers. These gentlemen, however, have as a rule paid a high price for their experience and its exclusive possession is of value to them. Some firms have spent thousands of dollars with the result of ascertaining that a given market is not one in which their goods can be sold at a profit. Such things are common enough but are not proclaimed from the housetops. Others have succeeded in quietly developing a nice little trade in certain lines in certain markets. They are not as a rule anxious to spread the news of their good fortune throughout the trade. This source of information, therefore, although undoubtedly the best in the world, is barred — and properly barred — to the investigator.

In this situation — which I have outlined at some length and which I have endeavored to describe fairly and frankly — the New England Cotton Manufacturers' Association has presented to it an opportunity that merits the serious consideration of its members. If under the direction of your able secretary, whose interest in the subject of foreign trade is well known, you would undertake to collect all the information requisite to gaining a clear idea of the opportunities for American cotton goods that really exist in foreign markets, you would perform a service that would be of incalculable value to the trade and the nation. A

careful study of the statistical situation in the various markets of the world will reveal a considerable number that it would hardly be worth while to investigate in much detail. It would be sufficient to collect and summarize such data as has already been published. Certain other markets are sufficiently well known to render additional investigation unnecessary. A few remain where the chances of developing a profitable trade for American goods would probably appear to be sufficiently favorable to warrant the Association in sending a trained observer, who is familiar with the practical details of manufacturing and selling cotton goods, to study the situation carefully and report. I submit that this useful and necessary work can be done more economically and more efficiently through an Association like this than any one else can do it. Others could undertake it only as an act of philanthropy — and the New England Cotton Manufacturer's Association assuredly desires no one's charity — or as a means of promoting their own ends. You can do it with profit to some of your members and with benefit to all.

A brief consideration of the really significant facts of the present situation in the American cotton goods trade will indicate the timeliness, indeed, the urgent necessity, of such an investigation. It is superfluous to burden you with statistics showing the greatness or the marvellous growth of the American cotton industry. Every gentleman here present who is connected with this great branch of the nation's activities can justly pride himself upon the reflection that "Of no mean country am I." In point of cotton consumed this country's mills now rank first in the world, although in number of spindles and value of product they are still far below those of Great Britain, but with the gap that separates them growing narrower every year. In the thirty-two years since 1870 the value of the product of American cotton mills has more than doubled, the consumption of raw cotton has increased five-fold and the number of yards of output has increased more than four-fold, the apparent discrepancy between the gain in value and in quantity being explained by the fact that prices have fallen more than one-half during this period.

Coincident with this gratifying increase in the output of American mills, exports have increased five-fold, while imports have gained less than 50 per cent. and in percentage of domestic consumption have remained practically stationary. There has been, however, one disquieting element in this wonderful growth that I desire you to consider attentively as the most significant feature of the domestic situation. This is the fact that the capacity of the mills has shown a marked tendency to outrun the requirements of the domestic market. That it has not actually done so, with resulting over-supply and disturbance of prices, has been due to the amazing increase in the domestic demand during the last three years. The increase in mill capacity, as you all are aware, has been most rapid in the South. In 1880 the 164 mills in the South had only 561,360 spindles, of which, however, all are running. The last decade has seen a remarkable increase both in the number and the size of the Southern mills. In 1896-7 there were 375 mills in this section having 3,456,537 spindles. Of these 258,992 were not running in that year, according to the careful record kept by the *Financial Chronicle*. In 1900-1901 the number of mills increased to 531 and the spindles to 5,819,835, of which no less than 345,952 were idle. In 1901-1902 the number of mills was 570, of spindles 6,408,974, and 229,553 were not running. This showing at a moment when domestic demand is admittedly at its maximum and exports at the highest point yet reached, indicates a serious danger of over-production should the home trade fall off during such a period of depression as may come at any time, or should the foreign market for a portion of the product of these mills be cut off.

In the North the number of spindles has increased much less rapidly, rising in the four years 1899-1902 from 14,290,000 to 15,150,000, an increase of only 860,000, and of only 100,000 in 1902. The increase in the South, on the contrary, is as rapid as ever, new mills and additions to old mills giving the imposing aggregate of 975,262 new spindles to be in operation during the current year. Now I submit to your careful consideration, gen-

tlemen, the fact this growth, that gratifying as it undoubtedly is to every patriotic citizen, places upon you a greater responsibility than ever before to extend your foreign trade in order to provide an outlet for these myriads of busy spindles whenever domestic demand, from any cause, declines.

A properly developed export trade is like a balance wheel for domestic industry, rendering constant and even a demand that if it depended on the home market or any single market alone might fluctuate seriously. Wars, panics, hard times, famines, pestilences, droughts, floods, tornadoes, volcanic eruptions, earthquakes and strikes are never universal, and declines in the demand in one country due to any of these causes are apt to be offset by improvements in the demand elsewhere. This suggests a fact of serious significance with regard to the distribution of our present foreign trade. Of the total exports of cotton goods from this country last year 48.4 per cent. went to China, while 51.4 per cent. went to that market in 1901. This is too large a proportion in view of the fact that the Chinese market is more liable than any other in the world to violent fluctuations in the demand, owing to local disturbances or the influence of foreign powers—two factors wholly beyond the control of our manufacturers and even outside the range of reasonable foresight. You all remember how the Boxer outbreak of 1900 compelled a number of Southern mills to close, while others threw stock, manufactured primarily for abroad, on the domestic market. The large increase in the number of idle spindles for that year shows the intimate relation that exists between these figures and the state of our foreign trade, while the unfavorable influence exerted upon the American cotton industry as a whole, by the abrupt stoppage of the China trade, indicates the importance of this outlet to our prosperity. Many of you may have failed to notice the remarkable fact that during the past few years an advancing market for cotton goods has always been coincident with business with China or following close upon it. This condition, gentlemen, is not a safe one. Too many of our eggs are in one basket. Or, to return to the simile I used a few moments

ago, our export trade balance wheel is too liable to break down exactly when we need it most to steady domestic industry. It is highly important, therefore, that we should set ourselves to discover, if we can, new foreign markets for our cotton goods so that in a wider distribution and a greater variety of goods exported we may secure that constancy of demand which is so desirable in export trade. Even the vast Indian market which is entirely monopolized by Great Britain, and which is equal in value to five times our entire export trade in cotton goods, does not dominate the British export cotton trade to the extent that China dominates ours. Every rumor of renewed Boxer rebellion, of Russian encroachment in Manchuria, should be a warning to us to extend our foreign markets against a day of possible disaster.

The total cotton manufactures of the world that entered into international commerce in the year 1901 were valued at about $625,000,000, or probably not far from one-third of the total production. The amount was still larger last year, but complete figures are not yet available nor are the changes instructive. The share of Great Britain in this trade amounted to more than that of all the rest of the world combined, while that of the United States was hardly one-twentieth of the whole and was less than that of either Germany, France or British India. These facts should tend to make us modest, but there is nothing that is in the slightest degree discreditable about them. American cotton manufacturers have been called upon to supply the greatest and fastest-growing market in the world. Until now it has required practically all their energies and their available capital to keep up with the increase in the domestic demand.

The export of cotton goods is, however, no new thing. These exports have exceeded $1,000,000 annually for more than eighty years, the total rising steadily year by year during the thirties and forties until the decade prior to the Civil War, when they attained a position of considerable importance, averaging over $7,000,000 for the decade, and reaching $10,934,796 for the year 1860. During the war and for some years thereafter ex-

ports naturally fell to a very low level, going below a million and a half in war time and below two and a half millions in 1872. There was a rapid recovery in the early seventies, however, the exports exceeding ten millions for three consecutive years. The average for this decade was six and a half millions. For the next decade it was nearly double, or twelve and a half millions, and in the decade ending in 1900 the average exports were $16,924,035. For the fiscal year of 1902 the exports were valued at $32,108,362, and for the calendar year at $33,274,907. For the first two months of the present year the exports of cotton goods have aggregated $5,682,889, which would give a total of over 34 millions for the year if the rate is kept up. This brief outline history of the growth of the American export trade in this field also indicates that the time has now come when a more thorough study of foreign markets should be made than has heretofore been undertaken. A trade amounting to $34,000,000 annually is of great importance not only to the cotton industry itself, since it takes nearly ten per cent. of the total output, but to the country as a whole.

In order to indicate more clearly the exact points regarding which fuller information than any heretofore available is essential it will be worth while to review briefly the principal foreign markets for American cottons, touching incidentally upon the extent and character of the trade now actually enjoyed by American manufacturers and upon the lines in each market in which a larger trade is reasonably possible if well-directed efforts are made to develop and retain it. The great continent of Asia is pre-eminently the most promising field for the disposal of cotton goods by such countries as have a surplus for export. Of the countries there, China is naturally the most interesting to the American cotton manufacturer. We sent to that market last year, as you all know, cotton cloths to the amount of 328,419,489 yards, valued at $16,048,455. These goods went almost entirely to northern China, more than 94 per cent. of it being distributed eventually through Tien-Tsin, Newchwang and Chefoo, Shanghai being merely a shipping

point in this trade. The goods consisted almost wholly of standard 2.85 yard, 3 yard and 3.25 yard brown sheetings and drills in pieces of 40 yards. There is a slow growth in some other lines, notably 3.50 yard, 64×68 and 40×60, and 4 yard, 56×60 and 48×52, these goods going chiefly to southwest China. There is also a fair outlet for Canton flannels and some time since, when print cloths were from 2½ cents to 2¾ cents for 28-inch, 62 squares, samples were sent to China and Japan and brought some business but the later advance checked this trade.

The success secured, however, suggests that this is a good line to investigate further and one in which a profitable trade may very well be built up. Every effort should also be made to extend American trade in the teeming provinces of southern China where at present we are doing virtually nothing. The marked success achieved by our manufacturers in the north proves that it is perfectly possible to produce goods such as these people requires at prices within the reach of the buying classes there. A market of 400,000,000 inhabitants is most assuredly worth investigating with the utmost care and it will unquestionably be advisable for this Association to send a trained observer there to study the requirements and conditions in detail. It is especially desirable to study the opportunities for developing a trade in American yarns in this market. British India at present enjoys the bulk of the yarn trade of China and the low price of labor in that country will render competion difficult and in some lines absolutely impossible for the present. I am convinced, however, that in many of the coarse yarns the South can compete with any country iu the world, India included. China imports yarns to the value of $35,000,000 annually and the factors that influence the placing of this trade deserve the most elaborate study.

In the rest of Asia the opportunities awaiting the American manufacturer are undoubtedly less promising than those in China. In Japan we have never succeeded in developing much of a trade, notwithstanding the fact that Japan is a large im-

porter of both yarns and piece goods. Such tentative efforts as have been made by our manufacturers to interest Japanese buyers have met with a very fair degree of encouragement and there seems every reason to believe that considerable business could be secured if we were to go about it in the right way. There are, as you know, 1,500,000 spindles in Japan and considerable weaving, but it will hardly be in the coarse grades made by the Japanese mills that we would undertake to compete. Japan buys cotton goods in considerable variety and it will be in some of the better grades that most success can be looked for. This market, like China, should be a good one for American yarns. Our exports of cotton yarns are now so insignificant as to receive no notice whatever in the statistics of the treasury department. The probabilities in favor of our achieving a substantial success in foreign markets with these goods are so great as to warrant an immediate and concerted effort in that direction.

It is not likely that any great progress can be made by our manufacturers in India, but it is a fact that standard (2.85 yards) American drills are sold there steadily though not in great quantities, and that there is occasionally some business in 4 yard sheetings. India, although a large exporter of coarse yarns, is also a heavy buyer of finer yarns, and there is always a possibility that American manufacturers may develop a nice little trade in some line of these goods if the market were carefully studied. The Indian imports of piece goods are so vast, two and a half billion yards valued at nearly $125,000,000, that it is altogether likely that we can find a number of lines in which our manufacturers can secure at least a foothold and in so great a market a relatively small trade may well prove extremely valuable.

Before passing from Asiatic markets I wish to say a word regarding the opportunities in the East Indies, including Java and the other populous islands in the Indian Ocean. Properly speaking, these markets should perhaps be considered under Oceania, but most of this trade passes through the great port of

Singapore, except the portion carried from Netherlands direct, *i. e.*, without trans-shipment. The Dutch East Indies are the third largest buyers of cotton goods in Asia, and there are very good reasons for believing that our trade in that market can be extended, particularly through houses having their headquarters at Singapore. With respect to the yarn trade of the whole of Asia, it is important to recall that most of the weaving is by hand; there are very few power looms. This will materially affect the matter of supplying yarn to these markets, but will not in the least prevent us from doing so.

In Africa, American manufacturers have long enjoyed a profitable trade in the Red Sea ports (including also ports in Asia), the chief demand being for 3.25 yard sheetings and moderate quantities of 3.50 yard sheetings. In Italian Africa, "Americani" is the term applied to most of the cotton goods imported, but it is likely that most of the goods sold under that name are no longer of American manufacture. In Madagascar, the French prohibitive tariff has utterly destroyed a trade that once amounted to more than half a million dollars annually. In Egypt we have never done anything worth mentioning, although that country buys over 13 million dollars' worth of cotton goods annually. South Africa has for many years bought some American cotton goods, the trade possessing considerable variety as to grades. South African dry goods buyers are much like those of any American city in their desire to secure novel and attractive styles for their better class trade, and American manufacturers can undoubtedly increase their business there by pushing such goods as are likely to be attractive. There is also a large consumption of lower grade cotton goods for the natives in all parts of Africa — a trade which our success in Italian Africa should cause us to investigate carefully. The history of American trade in Africa has been an instructive one. Several times enterprising manufacturers have opened up promising markets, only to lose them after a few years. Our best trade with the continent as a whole was nearly twenty years ago.

In Australia and New Zealand we have done better than is

generally supposed, although our trade is still small compared to that of Great Britain. The principal drawback to American trade with Australia is the fact that manufacturers who welcome Australian orders when trade is dull at home, frequently neglect their customers there when domestic trade is brisk, thereby forcing them to buy elsewhere and causing a serious lack of confidence in American business methods. Australian buyers also object somewhat to the American system of quoting discounts, preferring a simpler form of statement. The principal fabrics bought for this market are 8 and 9 ounce denims, while bleached cottons are bought in limited quantities in medium grades. Lately there has been some buying of 4 yard brown sheetings and a demand for mercerized goods for linings and dress purposes. There are numerous overall factories in Australia and a large trade might be developed in supplying these with such fabrics as they require. The minor markets in Oceania are individually of little importance, but in the aggregate they buy considerable quantities of cotton goods, which constitute the chief wearing apparel in all of them. Very little comes from the United States, Germany supplying most of the trade.

European countries are large importers of cotton goods, the total imports for that continent being the largest of any of the continents save Asia. This country secures little of the trade, although it is an interesting fact that one of the most popular brown sheetings in Turkey is of American manufacture. It is also worthy of note that hand weaving is still carried on throughout continental Europe to a much greater extent than is generally supposed and in general that the imports of yarns are very large. Some of the imports are doubtless for re-export, and in this connection it is well to recall that most of the trade for French Africa is handled at Marseilles, that for the Dutch East Indies at Amsterdam, and that many of the large German importing and exporting houses are ready to buy in the cheapest market whatever they require for their over-sea customers. If satisfactory connections were established, it is probable that a

considerable trade in American goods could be developed through such European houses.

Next to China, the Spanish speaking countries of America taken collectively, constitute the most promising market for American cottons and any investigation that might be undertaken with a view to developing new outlets for our mills should include the sending of an expert to most of these countries. It is not my purpose to detain you with more than the briefest possible glance at the opportunities offered in this part of the world, since the conditions in almost every country are peculiarly local, rendering generalizations regarding the field as a whole of very little practical value. Throughout Latin-America cotton goods constitute one of the leading articles of import, but the United States has thus far succeeded in securing relatively little of the trade. The cause usually advanced for this is that our mills are unable to compete with those of Europe, and especially of Great Britain.

The average price of the English cotton goods sold in South. America during the last two years is officially stated at 4½ cents per yard, while that of American cottons is given at 5 cents per yard. This wide margin would certainly account for our inability to make better progress, although it is due in part to the fact that our exports have been of a somewhat better grade than those of Great Britain, but I am convinced that the indifference of American manufacturers to these markets is in reality the main cause of the poor showing thus far made. A careful study of our exports during an extended period reveals the fact that each marked increase in our cotton goods trade in Latin-America coincides with a period of more or less severe depression at home, while the subsequent sharp declines that invariably occur are clearly due to the resumption of a good home demand.

Now I would respectfully urge that no export market can be won and held by intermittent effort. It is an up-hill matter at best to secure a foothold in these countries. English goods are standard everywhere and trade connections have been established with that country dating back in many instances for half a

century. Buyers are moreover most conservative regarding changes of any kind, either in styles, mode of payment, or in the houses which they do business. If, under these circumstances, they are induced, after much effort, to give a trial order for American goods, only to be refused a duplicate order if the goods prove acceptable, owing to domestic business having improved in the United States, it is no wonder that they are extremely averse to repeating the experiment.

It is of equal importance to bear in mind the fact that the wishes of foreign buyers regarding styles, widths, length of pieces, packing, etc., must be paramount or the volume of business secured will always be meagre. Not very long ago a dingy looking sample of print cloth was handed to an American manufacturer with an order for one thousand pieces of the same kind for a South American country. The manufacturer glanced at the sample and said "We don't want that order; would be ashamed to let such a print go out of our place. The style is years behind the times." The buyer replied that in that case the order would have to go to Manchester where it had always gone. It was his best seller. Now I do not deny that the American printer had some reason in turning down that order, but obviously this is not the way to build up an export business. It is idle to entertain the delusion that we can "educate" foreign buyers to prefer superior qualities or styles or to adopt different business methods. If we set out, however, to supply each market with what it desires we can, I am firmly convinced, at least double our present trade in Central and South America and there is every reason to believe that we can maintain our position in each market if, when times are good at home, our manufacturers will simply make up their minds to do so.

The last markets to which I need refer particularly in this general review are those in our new colonies and in Cuba and the West Indies. The Porto Rican trade shows what can be done in these markets by intelligent and systematic effort. That trade, as you all know, is in strong and able hands and our exports of cotton goods which before the Spanish War fell as low

as $3,723 in 1898 and never went much above $35,000, now exceed two million dollars in annual value and are still increasing. A prominent exporter to this market remarked recently that he no longer considered Porto Rico as foreign any more than he did New Jersey. Buyers from there now came into his establishment and bought right through the house from notions to domestics. In Cuba we have made considerable progress, compared with conditions prior to the war, but are still a long way from dominating the market. If congress passes the reciprocity treaty there will be a remarkable increase in our cotton trade with Cuba. I know personally of several large houses in New York that are preparing to spend thousands of dollars in pushing their Cuban trade if the treaty is approved by the House of Representatives next fall. In the Philippines we are at present doing virtually nothing; sending goods to the value of less than $100,000 out of two millions imported. We can unquestionably do much better than this and the careful reports of the various government commissions furnish a great deal of material regarding the opportunities in this line awaiting our manufacturers there. In the Hawaiian Islands we already have the greater part of the trade, our shipments there averaging about half a million dollars in annual value. Turning now for a moment to the West Indies other than Cuba and Porto Rico, I simply desire to note that in several of these islands our manufacturers have already established what they term "a nice little trade." The business with Hayti is especially large, although reduced of late by political disturbances, and in former years used to be extremely profitable. Sellers made 2, 3 and even 4 cents a yard at times, but selling is much closer now. Our trade in the other lesser Antilles is fairly large and steady and although each island or colony buys comparatively little the aggregate trade is of some importance.

In this brief review of the world's trade in cotton goods I have endeavored to show that there are many more opportunities for the development of a greater trade for American manufacturers than they now enjoy. Without wearying you with statistics, I

will put it that roughly there is a reasonable likelihood that by devoting yourselves to the problems presented in the foreign field you can before 1905 increase your exports to Asia by at least $10,000,000, to Africa by $2,000,000, to Central and South America by $5,000,000, and to the American colonies and Cuba by at least $2,000,000. The situation in the domestic industry renders it highly important that such an enlargement of the export outlet should take place, while the situation in China renders it desirable that our mills should have a wider distribution for their product, making them less dependent upon conditions in that most unsettled country. In short, everything points to the importance of expanding our foreign market for cottons. If this Association will take up the matter and undertake to investigate thoroughly the conditions in foreign field it will perform a service for its members, for the trade, and for the country, the value of which cannot be over-estimated.

The PRESIDENT. Gentlemen, it seems as if we ought to have some discussion on this very valuable and interesting paper. The subject is certainly of the utmost importance. I am very glad to notice that the secretary of the Boston Chamber of Commerce, Mr. E. G. PRESTON, is in the hall. Mr. PRESTON perhaps could favor us with a few words on the subject and the members would be very glad to hear from him.

Mr. E. G. PRESTON. Mr. President and gentlemen of the New England Cotton Manufacturers' Association: Nothing was farther from my expectation when I came here this afternoon than that I should be called on to say anything. I came here to be instructed, and I have been greatly instructed by the paper of Mr. VOSE. I consider it a very timely discussion. When we consider the dimensions to which our foreign trade

has grown in the last fifty years, that today it aggregates nearly $2,500,000,000 and our exports amount to $1,500,000,000 — when we consider the enormous increase in exports of manufactured goods, the products in which you gentlemen are vitally interested, I think we must all agree that the foreign trade is an important element in the manufacturing industry. I consider it an extremely timely paper today, for the reason that in the *Boston Herald* I read an address delivered last night before a commercial organization, in which the statement was made that time was being wasted in considering foreign markets and opportunities for the increase of foreign trade — manufacturers had better direct their attention to increasing the market at home for their goods and to improving their product here than wasting time to enlarge their foreign markets. Strange to say, that statement was made by a very important representative of your trade. In view of the effect of the Boxer troubles in China upon the cotton industry in this country, which was very great, and which, if the trouble had been longer continued, would have been greater still — in view also of the testimony given by Mr. JOHN FOORD of the Asiatic Association of New York before the committee on foreign relations of the United States Senate the other day, that because of the fact that Chinese orders for cotton goods did not come in last year at the usual time, namely, in October, but were delayed until December, the same trouble which occurred during the Boxer trouble also threatened — it seems to me perfectly clear that the foreign trade in cotton goods vitally concerns the manufacturers of cotton goods. Of course the concentration of the trade in China points to the danger which Mr. VOSE has spoken of, the danger of having too many eggs in one basket. It is the danger that Boston faces all the time in the character of its general export trade. Eighty-five per cent. of the exports of Boston consist of six staple articles, and 90 per cent. of the exports of Boston go to Great Britain — to one country. It is clear that a serious interruption will occur to the trade if anyone of those articles of commerce or if Great Britain is the subject of financial or commercial disturbance.

Mr. FREDERICK EMORY, the chief of the Bureau of Foreign Markets in the Department of State, in his last report, which was received only a few days ago, points out that when we entered into the foreign markets in 1894, as we did, right after the recent financial crises, we took Europe by surprise — in fact, we surprised ourselves. The necessity was thrust upon the manufacturers of this country to find an outlet for surplus goods. Mr. VOSE — I am quoting freely from Mr. VOSE, because his paper constitutes the entire text of my remarks and has given me what few thoughts I am able to repeat to you — Mr. VOSE has pointed out that the tendency in the production of cotton goods in this country is inevitably to outstrip consumption here. That is true of every line of trade just as much as it is true of cotton goods. Is there no relation between the fact that in the last nine years, beginning with the disasters of 1893 — and it seems to me we may date our exporting prosperity from that time; it is one of the bright linings to the cloud — is there no relation between the growth of the exports of manufactured goods since 1893 and the enormous prosperity of this country? And think for a moment of that market being shut off to which we have turned the surplus of our products — that export trade being shut off and the flooding of the market in this country with goods which now find a profitable market elsewhere! would it not bring immediate disaster?

It seems to me there is no subject which can more appropriately engage the attention of this important organization representing as it does perhaps the most important industry in the United States, than the consideration of foreign markets, because while it is necessary now, it is undoubedly true that it will be infinitely more necessary in the years that are immediately before us to find the market for our surplus products. You who are in this industry know — and I speak with that diffidence which becomes a man who knows nothing about the industry; perhaps that is one of the reasons why I speak with freedom, because I am not embarrassed by any knowledge of the facts — but one of the things which interferes

with export trade in other lines, and I dare say it does in this, is that manufacturers are not willing, as Mr. VOSE has pointed out, to consult the wishes of the buyer. Your secretary, Mr. WOODBURY, related an incident in my hearing at a dinner a few evenings ago which I will repeat to you. A corset manufacturer of Connecticut wished to sell his corsets in the island of Cuba. He sent for a Cuban corset; he duplicated that corset in every detail and sent a large shipment to Cuba. He could find no market for them in Cuba; he could not sell them. Upon careful inquiry his representatives found that the reason was that they were not done up in blue tissue paper and sold in a box, as was the custom in Cuba.

That is a typical illustration, I take it, of the difficulties which our manufacturers find in extending their trade to foreign markets. The foible of the foreigner must be consulted. And when our manufacturers persistently attack the foreign market as they attack the markets of this country, they will secure it, and the prosperity which we have so long enjoyed will, I am sure, be permanently assured.

Mr. C. J. H. WOODBURY. As Mr. PRESTON cited the first portion of the incident, relative to the corsets in Cuba, permit me to add the remainder: Lest we consider this fashion and packing an unreasonable foible, what would be the fate of a shipment of foreign shoes to the American market if the soles were not smoothed, colored, and polished in the expensive and utterly useless manner which our foibles require!

The PRESIDENT. Is there any further discussion? We will now proceed to the reading of the next paper on the programme, Factory Tenements, Mr. ARTHUR H. GULLIVER of Waltham, Mass.

Mr. ARTHUR H. GULLIVER. Before reading the few pages that I have written on the factory tenement problem I want to say a word to the manufacturers here present. It seems to me that the present time is one that should occupy our atten-

tion very thoroughly on the subject of the quality of our labor. There is no question that the members of the New England Cotton Manufacturers' Association who are located in Massachusetts will have to demand of their laborers a higher class of intelligent work than they have ever done in the past. There is no question, gentlemen, that the time has come when it must be insisted upon by every manufacturer that every employee of a cotton manufacturing plant shall have the interest of the concern the main and the most important part of his work. Now, with that introduction I want to read the paper that I have written. It is a necessity which I think all of us that are located near or around a manufacturing city fully appreciate, — that intelligent labor is almost impossible to get during the so-called good times. There is nothing that makes it harder to run a cotton manufacturing plant than to have every other industry — steel, iron, hardware, dry goods — to have every one of these industries in the most flourishing condition; for I do not think there is any place where the operative leaves any quicker than a common, average cotton mill. I think there are other members of the Association that will bear me out in this statement.

FACTORY TENEMENTS.

ARTHUR H. GULLIVER, Waltham, Mass.

The consideration of how the operatives in a mill should be accommodated, is one that is always difficult to settle. The most satisfactory way in which to handle any class of labor is to have its sole connection with the mill one of work, — when properly performed it will mean continuous employment; poorly done, immediate discharge. If it was possible to arrange this with the class of operatives that present conditions make necessary, this would be the only way that any one would like to employ the labor, but as long as the matter of family life and employment of hands who are necessarily under the control of the parent seem to be the only consideration that will satisfactorily operate a cotton mill, we cannot give up the somewhat paternal system of not only having the hand himself perform his work properly, but provide for satisfactory employment of all the members of a family that wish to work. Whether it is possible to make a mill so little dependent on a family that it can run without it, the coming years will settle; it certainly is not the case today, as the kind of work is so arranged that the only operative that is available for certain classes is one that must be of the family.

If the changes in machinery which are at present being made, by which the amount of work is not limited by the machine itself, but solely depends upon the ability of the operator to do a full day's labor, will extend to all departments of the mill, the difficulty of family employment and the care of tenants will be removed entirely from the consideration of the manufacturer.

We understand that the use of the automatic loom has really removed to a certain extent this condition from the weaving room entirely. Whether it can be done in the ring spinning department depends upon conditions which are not yet settled.

It is true that there are certain mills which are able to employ nothing except hands that are old enough to be considered by themselves, and not as members of a family, and can run this department at the cost that will mean successful manufacture with only this class of help. But this is not the case with every mill, nor is it the case with the average mill. It probably will be more apt to be used by the mill located in the city than one located in a small place. The carding can no doubt be run without the use of very small help, and it can turn out a good product at a low cost without this class of labor. But until the changes are made in all the departments it is necessary to consider how the family can most easily be used and employed in the various kinds of work.

That brings up the question of the tenements as an important one with every manufacturing plant, and it compels us to accept this condition as probably permanent for some little time to come in the employment of mill labor. This brings us directly to considering how the house problem can be most easily handled and give the best results.

The most important factor in a successfully running mill is a permanent, contented and industrious class of operatives. The attainment of this condition has, both in the country and city mill, largely to do with the satisfactory tenements that are furnished for the families. The consideration of how these tenements should be handled is one that should certainly receive our attention. We can afford to devote some little time to the consideration of the easiest way that they can be made attractive to the occupant, and available to the corporation.

The mill that is equipped with an abundance of tenements that are properly located has an advantage which is hard to overcome, and this is felt by its competitor which is not provided to properly house its operatives. This advantage will not

always be obtained by insisting on the exact return that capital invested elsewhere would net, as it is necessary to take into consideration the saving in cost that it means to be able to take and place at any time a family that the mill requires. It is more economical to have the number of snch houses larger than is required to exactly maintain the number of hands needed in running the plant. Again, it is advisable to have these houses constructed in a way that would enable each tenant to practically control his or her yard, and as far as possible to have their own stairs and front door, even if the house is located at a greater distance from the mill; this disadvantage is more than made up by absence of continual trouble between families, and also less desire to move, even if the returns offered by another mill exceed the wages they receive where they are employed.

If it can be done, houses of wood or brick that are arranged for only one family in one half of the house, giving each one a chance for some ground around the door that can be used for flowers if not for vegetables, will make it easier to hold the tenant in whatever house they live. The difference between the smaller and the larger tenements in a great many of the manufacturing villages makes it a continual source of annoyance, by the desire to move to larger tenements.

I would even go farther than this and would make, as nearly as possible, the rents of houses exactly the same, and in every case there would be provided a sufficient amount of ploughed land for each tenant to cultivate whatever garden he might desire on land owned by the corporation.

These advantages cannot be obtained in the mills located in the larger towns and cities of New England, but they are real, tangible assets, and the concern which maintains its property in reasonable repair, and is willing to make the houses neat and comfortable, will be better supplied with whatever class or nationality they take for workers.

It seems to have become a crying need that the competitors of these mills who have the above advantages, who unfortunately

are situated in cities where the tenement property that the mill may hold is inconveniently located, and is compelled to bear a larger share than it ought of the city expenses, in the item of rent, shall seek an outlet where satisfactory houses can be built and rented for a fair amount to the families that take them. It seems as if this advantage could be obtained only by the use of the electric railway facilities which are so rapidly covering the whole of the settled portion of New England. Such settlement cannot always be maintained by the mill itself, but there is no reason why it should not offer inducement to capital to maintain such houses, provided that the person in charge of the property should reside in one of them himself.

It is well known that in the outskirts of our manufacturing cities, where there is slight attention paid to building laws or sanitary regulations, the foreigner, from whatever country he may come, locates a house containing from twelve to sixteen tenements, lives in one of them himself, and succeeds not only in maintaining his own family, but in laying by from the rents paid by the other tenants a large sum in a very few years. This methed of herding together a large number of people is not only dangerous on account of fire, but from the standpoint of the good citizen is very disastrous in regard to the conditions of the families themselves. Children brought up under these surroundings are fully as unfortunate and untrained as those of our large cities who are living in the tenement district. The very fact of this crowding, although it may make cheap houses available for the mill, lowers the standard of work that the operatives can do. There is no question that the careful and liberal policy of some of the Southern mills will reap its own harvest in keeping on its payroll the most satisfactory laborers that any cotton mill in that section can have. However different the house conditions may be between the South and North, the money that has been spent for electric lighting, libraries, halls and schools, will bring its own profit in this very way of contented, satisfied operatives. It seems as if this condition had only been appreciated recently by men of the country mills in

New England, who, on account of liberal purchase at the time of the building of the mill, practically controlled land enough to furnish all the houses that the present size or even the future growth of the plant would require.

Neglect of sanitary conditions and the careless maintenance of the property really take away from the actual profits of the mill, although the tenement account might show on the right side. How the rate of rent should be fixed it is impossible for any one to say, unless all the conditions of the special problem may be ready for examination. Without any question, the lower this can be kept, and still make practically a balance account, the better for the mill and for the families.

The repairs for these houses depend also very much upon local conditions. If there is an absence of crowding, and the two-tenement system, it should be very light. How these should be kept in order, and how handled, will also depend somewhat upon the conditions of each case. In general, all the repairs, whatever their character, should be done directly by the men employed by the mill. The man who has charge of these houses should be ready at any time to furnish the manager of the mill an exact account of their conditions, and should feel a personal interest in the low cost of sufficient repairs.

A form of lease should be drawn that would give control of the house with the shortest possible legal notice after the tenant has given up work or has proved unsatisfactory. This is necessary to give sufficient restraint to lawlessness and to make each family feel that the occupancy of such a house at so low a rent depends on their own conduct. The more nearly that this can be brought to each one in this way, the better will be the results.

This competition in the matter of obtaining families of value always results to the detriment of the city mill, unless some such plan as suggested can be carried out to obtain respectable low-priced tenants. It is something that is always present with a mill so located. As it is far from easy to take and place the families which regularly come looking for work, it would seem

to the manufacturer that there ought to be some interest in the cities, whether they are cotton manufacturing cities or not, in providing for this class of the population. Whatever may be said of the cotton mill operative, there is no class of laborers which is more continuously employed, and none whose value is more certain to the place where they are located. The question will come up in regard to those miils which have sold their tenement property that they would be able to reduce the value of their taxable estate, whether they should not demand from the municipality this very reduction that they must obtain to hold their place and still retain the houses that they have, and the land on which they are built.

There probably is not a city in New England that does not feel that it is proper to get all it can out of manufacturing property. I think the President will sustain me in this statement. It is easy to find, because it is right in sight, and the average assessor of a town in New England feels that if he can get hold of the property and make the valuation of it equivalent to what it ought to cost according to his idea, it is good business. Now it seems to me that the manufacturing interests in New England should be treated more fairly than this. It seems to me that the rate of taxation on manufacturing property should depend upon conditions which each city should make as favorable to the manufacturing plant as possible.

However far we may stand from Socialism, it must be admitted that it is necessary to exercise a certain control over the class of houses that shall be occupied by those who are unable to pay the higher rents. It is certainly the better business policy to cover a large area of city territory with houses of moderate size, properly supplied with running water, and with sewer connections according to the rules of the board of health, than to permit the erection of the three and four story house, even though that may also be built so that the buiiding commissioner will accept it. The experience of the far western cities that have insisted on an apportionment of land, so that there will be plenty of space around the houses, is certainly

more economical from the standpoint of health. Again, the future supremacy of the New England Manufacturer lies in a class of operatives that will bring trained skill to the handling of the cotton fabrics.

We certainly must expect that contented family life, under conditions that we have stated, will make it more probable that such a class can be obtained. It is well worth our consideration whether the securing of this class does not demand a more careful attention to the absolute necessities of the question of satisfactory houses. It should be admitted without argument that although the mill is unable to make the conditions where they do not own the property, certainly they can direct the employment of capital in giving them the facilities that they require to maintain their organization, and to be so placed as to increase as business demands the enlargement.

The PRESIDENT. As Mr. GULLIVER has referred to me I will say that I can bear him out in everything which he has said, both in reference to tenements and on the question of taxation. Perhaps it would not be fair for me to tell a good story which comes to my mind, because some people could easily locate the scene of action and it might be annoying to me at least, in time to come. But a little matter was brought to my attention a little while ago which was not in my own town, I must say for my own protection, where a tenement house or a tenement block was located in the corner of a mill yard. This tenement block was assessed at valuation to say $4,000. It was in bad shape and the managements of the mill decided that it was worthless as a tenement, and so they turned it into a store house. The assessors put the valuation up from $4,000 to $5,000, giving as a reason that the management would not make

a move of that sort unless they were to receive some benefit, and they certainly would not change the building from a tenement house to a store house unless they saw some benefit, and if there was a benefit, why should'nt it be taxed? And I think perhaps that is the principle pursued by a great many town assessors — and city assessors also — in valuing corporation property. Can anyone make any further suggestion on this subject?

Mr. JUSTIN A. WARE. Mr. President, I think that friend GULLIVER in his paper, describing a model tenement house for a factory village, omitted one very extreme and vital point, and that is the kind of partition that should be used between the two parts of a double tenement house. I think that in the average construction of a double tenement house the thin wood and plaster partition between the two halves has been the cause of more circuses between families than any other point you can mention. That partition should rightfully be of brick if it is a wood house, but if necessary to make it of wood it should be packed with mineral wool or some substance that is sound proof in order to stop the rackets that happen between the two families. As you probably well know, there are quantities of such houses constructed, especially in the South, with a plain wood and plaster partition between the two halves of the house, and it causes much trouble. Therefore the model tenement house should have a thick, sound proof partition between the two halves of the house.

The PRESIDENT. My experience has been, sir, that every partition in the tenement should be of — well, I will say armor plate. [Laughter.]

Most of us remember with great pleasure the very interesting paper which was offered at, I think, the Crawford House meeting of a few years ago on the American Textiles at the Paris Exposition. The author of that paper has very kindly consented to favor us again, and we will now listen to a paper on Cotton and Cotton Goods at the Louisiana Purchase Exposition, by Mr.

JOHN H. MCGIBBONS, the Eastern representative of the Louisiana Purchase Exposition.

[The paper of Mr. MCGIBBONS was devoted to a detailed description of the Louisiana Purchase Exposition to be held at St. Louis, and its numerous points of attraction.

As similar information will be given in illustrated detail before the Exhibition is opened, the Board of Government decided to omit the report.]

The PRESIDENT. There is now an opportunity to ask questions of Mr. MCGIBBONS for information.

As there do not appear to be any questions, we will pass on to the next paper on Native Spindle Whorls of North America and Adjacent Territory. The author, H. NEWELL WARDLE, is connected with the Academy of Natural Sciences at Philadelphia, and as an ethnologist, has been investigating for many years the methods of life of prehistoric nations which once inhabited this continent, particularly those of the far West and Mexico, and in the course of these investigations, great attention has been given to the clothing and the methods of its manufacture, but the paper is confined to a description of the spindle whorls which was made of pottery, stone and wood.

The information has been received that the author of the paper is quite ill and unable to be present, and it will, therefore, be read by the Secretary.

NATIVE SPINDLE WHORLS OF NORTH AMERICA AND ADJACENT TERRITORY.

H. NEWELL WARDLE, Academy of Natural Sciences, Logan Square, Philadelphia, Penn.

At the time of the discovery of America, the art of hand spinning was widely distributed among the native tribes, though few of the early writers seem to have deemed it worthy of mention. Among the wealth of new and strange impressions, that presented themselves to adventurers, this homely industry was too familiar an old world sight to call for comment.*

As a consequence of their silence, practically all our knowledge of the spinster's and webster's arts in the new world north of the present Mexican boundary, is derived from the study of textile impressions upon pottery and a few rare fragments of cloth, preserved in the dry air of the southwestern plateau or by chance contact with copper artifacts.

The extensive excavations of Mr. CLARENCE B. MOORE, to whose tireless exertions archæology owes the accurate knowledge of the mounds of the eastern seaboard, have failed to reveal a single pottery object which could be classed as a spindle whorl. Yet, spinning was undoubtedly practised by the people of the Atlantic slopes, only the perishable wooden whorls and spindles have left no trace in hut-site or grave.†

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* This primitive method was, until recently, to be seen in practice in the Pyrenees even as it still is in extreme eastern Europe.

† There are in the Douglass Collection of the American Museum of Natural History, thirteen "disks of stone and pottery possibly used in games" from Ohio. Four

In Arizona and New Mexico, the whorls were also perishable, but the same conditions which produced the mummies of the Cliff-dwellings, conduced to the preservation of the plain little disks of wood and mountain sheep's horn upon whose rotation so much of the comfort of life depended. They are seldom referred to in the accounts of excavations. Their relative frequency and lack of attractiveness are the sole causes for this neglect. Nevertheless, within a single culture, they display a surprising variety of form, being discoid, plano-convex, cylindrical or globular, and having a diameter of from one to two inches. That a people who carried the production of fictile ware to so high a degree of perfection as did the ancient Cliff-dwellers, should not have constructed spindle whorls of pottery, but of wood and horn, is strong evidence, not without corroboration elsewhere, of the antiquity of the textile industry among the folk of the cañon side. With them, as with the Pueblo peoples, spinning seems to have been so long established that it did not respond to the influence of the dominant industry.

Obviously, the material of the spindle whorl is as dependent upon local conditions as are the fibres whose utilization led to its invention. Hence, just as in the southwestern United States the cotton shared with the yucca its place in the tribal economy while on the north-west coast the hair or wool of the Rocky Mountain goat has largely given place to the beaten bark of the red cedar; so the wooden whorls of the eastern United States are accompanied in the plateau region by those of mountain sheep's horn, while on the north-west coast (Kwakiutl?) these are replaced by flat whorls, one and a half to two inches in diameter, fashioned from the bones of the whale.

Today, in the San Juan pueblo, simple, small pottery disks

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of these are peirced and are probably spindle whorls, while the eight unperforated pieces may be unfinished — the boring of objects of stone and pottery being always the final touch of the artizan — and the thirteenth, which has lost a segment, was evidently broken during this process. In the same collection, Illinois is represented by three perforated stone disks, about two inches in diameter, which, though highly ornamented, may be classed with the useful objects under discussion. (Plate I, Fig. 12.)

are in use for hand spinning, while in the Hopi town of Wolpi, undecorated whorls of horn, stone, bone and wood, are employed, and among the nearby Navajoes large wooden disks serve to weight the spindles. In the forest clad sierras of northwestern Mexico the Tarahumaras and Huichols are also dependent upon plain wooden disks, but the Otomi, on the unshaded Mexican plateau, picks up the ancient clay spindle whorls in his field and reapplies them to their old-time service.

A large majority of the pottery spindle whorls of the new world, in public and private collections, were the handiwork of Nahuatl-speaking tribes. In the hands of the inhabitants of the ancient Aztec capital, Tenochtitlan, (now Mexico City) and their kinsman, this household implement reached its highest artistic development on the North American continent.

PENAFIEL has well said, "The place wherein their ornamentation most resides is in their spindle whorls and bowls for spinning. In those magnificent utensils are encountered the best of Aztec ornament, and also a veritable decoration with mythological subjects. It is probable that to combine the varied collection of malacatls could reconstruct the figures of the Mexican mythology. Humanity marches to the same end but not always by the same ways, . . . and on their spindle whorls and religious vases the ornament confounds itself with a true decoration on which figure from the beneficent deities even to Tzontemoc, he who descends headlong in the midst of obscurity."*

A study of the collections of New York, Philadelphia and Washington has assured me that the Mexican deities seldom appear in person on the spindle whorls, being content to relegate that duty to their brute companions or symbols. At the American Museum of Natural History, at the Free Museum of Science and Art, at the United States National Museum, not one malacatl being a human figure was exhibited. At the Acad-

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*Dr. Antonio Peñafiel—Monumentos del arte Mexicano antiquo. (Vol. I, p. 1. See Vol. 1 of the plates also.)

PLATE I.—MEXICAN SPINDLE WHORLS.

emy of Natural Sciences of Philadelphia, the famous Poinsett Collection contains none, the Lamborn Collection holds but a single example — a plumed human head. This strikingly characteristic profile is doubtless that of a deity, and, in sympathy with a wide spread religious feeling, I present his effigy but hesitate to pronounce his name. (Figure 1, Plate 1.)

But if the gods do not grace this household implement, they certainly send their familiars, for frogs, monkeys (Figure 2), insects (Figure 3), and birds (Figures 4 and 5) are of relatively frequent occurrence, the last named or its derivatives, appearing on no less than 12 per cent. of the Mexican spindle whorls in the United States National Museum, while the publications of Preuss have shown this motif to be well represented on the whorls of the Berliner Museum für Völkerkunde.*

The decoration of fully one-fourth of the spindle whorls has assumed a geometrical character, or degenerated to such an extent that its original form or present significance is unrecognizable.

But of all the designs, by far the most persistently recurring, often so debased that it would be unidentifiable were it not for the testimony of the intermediate links, is the wind-snail of Quetzalcoatl — his wheel, or jewel of the winds. (Figure 6, Plate 1.)† It is to be seen in more than 45 per cent. of those whorls in our National Museum of known or presumptive provenance from Nahuatl-speaking territory, and this is equally true of the three Philadelphia collections.

That Quetzalcoatl's jewel was intimately associated with the spinster's art, is also indicated by the little tripod or ring-footed bowls wherein the end of the spindle revolved. When these spinning cups are decorated at all, it is with some form of the wheel of the winds. (Figures *7a* and *7b*.)

Just what was this connection? I believe it can be definitely shown that this symbol, while, when used as a breast ornament,

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*K. Th. Preuss,—Zeitschrift für Ethnologie, 1900, IV. p. 109, also 1901, p. 1.

†"Yahualli ehecatl."

habitually represented by the cross section of a snail shell, nevertheless, at its conception was nothing other than the spiral trail of the wind on the sand, which the late FRANK HAMILTON CUSHING long since pointed out as the origin of its northern congener. Consciously or unconsciously, it is to Ehecatl, lord of the winds,* that the appeal has been made for unnumbered generations, that the spindle may whirl, like a plant before the storm, fixed, but ever sweeping round.

It is interesting to note in passing that, according to Professor STARR, in certain parts of Mexico today, the name for whirlwind is derived from malacatl.†

In some measure the bird represents the same idea, that of speed, flight, though it is not Ehecatl, but Cozcoquauhtli, the vulture, or Quauhtlî, the eagle, which appears on these terra cottas. (Figures 4 and 5.)

Add to this, that the insect, as shown by Preuss,‡ was the emblem of the Earth mother and its significance was life, that the frog was the recognized symbol of Coatlicue, the "serpent skirted," goddess of flowing water and wife of the raingod, Tlaloc. And behind it all, deeper than all, I believe may be discerned one aspect of what Mrs. Nuttall § has so well called that eternal prayer for rain that went up from every shrine of the great southwestern tablelands, and, may I add, from every hearth and doorstone where the whir of the spindle was heard.

To pass to the tecnique, upon the vast majority of the whorls, the decoration, whatever its character, is incised. A very small percentage are painted in red, — occasionally black, — with or without an accompanying incised ornamentation. (Figure 8 a,

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*One of the appellations of Quetzalcoatl.

†Prof. FREDERICK STARR. Notes on the Ethnography of Southern Mexico (Proceedings, Davenport Academy of Natural Sciences, Vol. VIII, p. 18.)

‡Preuss. Loc. Cit. 1900. IV. Die Hieroglyphe des Krieges in den Mexikanischen Bilderhandschriften.

§ZELIA NUTTELL. The Fundamental Principles of Old and New World Civilization, Etc., p. 28. (Ethnol & Archæol. . . Papers of Peabody Museum, Vol. II.)

b, c.) One only of these can be definitely located at Etzatlan, in Jalisco, in the land of a Nahuatl-speaking people.

Unfortunately, that little group of delicately carved pieces, ranging from ¾ to 1¾ inches in diameter, of fine grained clay burning from a rich dark-brown to a brownish red, possesses no more definite data than "Mexico". (Figures 3 and 4).

The same is true of the small grey or black whorls of similar workmanship, which together with the members of the last mentioned group are the bearers of the frog, insect and bird designs. It is probable that the two groups arose at no great distance from each other. (Figures 2 and 5.)

Closely akin to the third group, if not identical with it, are those grey and black pieces of greater average dimensions. (Figure 6.) Among these the wind-snail is of most frequent occurence, though its representatives invade all the groups. Geometrical and debased ornamentation are often present. Of this class is one from Cholula, collected by Professor Holmes.

The above four classes are all plano-convex in form.

Small whorls of hard-baked, dull grey or brown ware, rather rude in execution, averaging one inch in diameter, of flat cylindrical, or slightly biconvex, or plano-convex form are decorated with lines forming squares or triangles. These constitute a fifth group of at present unknown Mexican provenance. (Figures 9 a, 9 b.)

The last of the decorated groups of presumably Nahuatl origin is closely paralleled by the Otomi (?) pieces from Metapec. Of dull yellow-brown or red-brown brick-like ware, with flat top and bottom, the one of considerably less diameter than the other, top, bottom and sloping side, or any two in combination, are moulded with a pattern whose essential feature is the wind-snail motif (Figure 10.) apparently centering in the valley of Mexico. This type seems rather rare and may for the present be referred to the people of the Otomi stock.

The ruins of Cempoalla in the State of Vera Cruz furnish spindle whorls of dull grey ware, ¾ to 1¾ inches in diameter, unornamented, or incised with scallops. They are bell-shaped,

plano-convex, or double convex. (Figure 11.) I strongly suspect that fuller data will consign group five also to this Totonacan culture.

South of this point, a wide gap occurs in our collections till the Chiriqui Province is reached. Professor Holmes, the recognized authority, says; "These whorls are not plentiful in the graves of Chiriqui but such as have been collected are quite similar to those of Mexico and Peru. . . . We have three examples, modeled with considerable attention to detail, but comparatively rude in finish. They are in the natural color of the baked clay, and are but rndely polished. The first is encircled by a line of rough indented nodes, the second is embellished with homely little animal figures, and the third with incised patters and rude incisions." *

In the Colombian region to the south, in addition to the ordinary plano-convex form, (Figure 16 a, b, and c, Plate II), three entirely new types make their appearance, but in exactly what localities they arose the available information does not permit of determination. All are apparently of the same dark-brown polished ware, cross-hatched with a decoration derived from textile motifs, but it is in their forms that their distinctive characters lie.

First, there is the stemmed type, somewhat resembling our common inkbottle in outline. It may terminate in a simply rounded swelling, or the neck may be capped by a square poll, — (Figure 13,) both classes to be seen in the National Museum, — or the head may be entirely lacking and the long neck, slightly tapering, rounded off, as in the six beautiful stemmed whorls of the Lamborn collection of the Academy of Natural Sciences of Philadelphia. (Plate II, Figures 14 a, b, c, and 15 a, b, and c.).

The second class of the Colombian region is represented by only two specimens within my ken, one in the Lamborn the

* Prof. W. H. Holmes. Ancient Art of the Province of Chiriqui, Colombia. Sixth annual report of Bureau of American Ethnology, pp. 149–150.

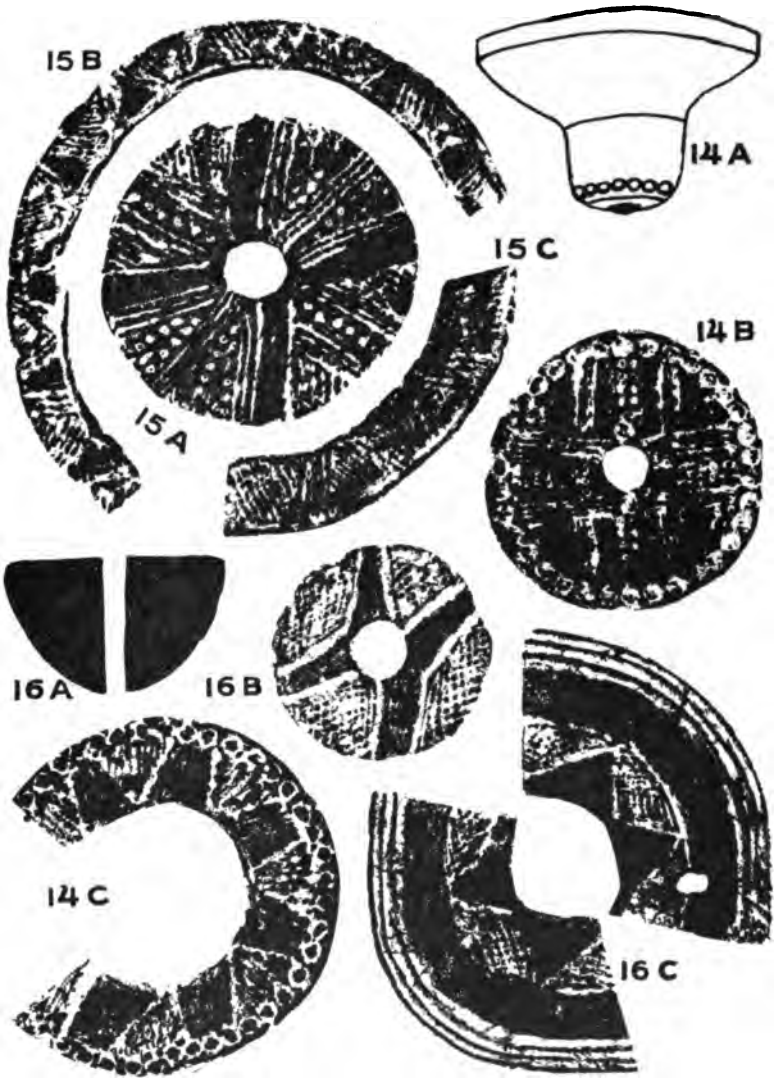

PLATE II.—COLOMBIAN SPINDLE WHORLS.

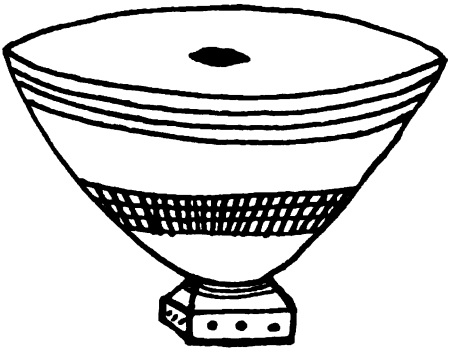

FIGURE 13.—SQUARE POLLED SPINDLE WHORL FROM COLOMBIA.

other in the United States National Museum collection. Their peculiarity is their rectangular form, decorated with bands and diamonds. All four sides of the Academy's specimen and the alternating faces of the National Museum whorl are obviously intended to bear the same device. (Plate III, Figures 17 a, and 17 b.)

Most characteristic, however, are the four whorls in the Lamborn collection, gracefully biconvex in outline and of superior workmanship, whose like I have seen nowhere else. (Plate III. Figures 18 a, b, c, and 19 a, b.) Their peculiarity lies in a hollow chamber which each possesses, containing respectively three, two, one, and no clay balls, Plate III 18 a which must have given forth, when in motion, the slight rattle so dear to the native of this great culture province. There can be no question of their usage, for in the deep incising of the largest, — the most beautiful whorl I have ever seen, — I discovered a minute fragment of died yarn. The color was a dull, lightish purple, but, when thoroughly cleansed, it showed that brilliant purplish red, thrown out by the so called seahare of our southern waters. We have the authority of Professor Starr that dye is made today from this snail by the natives of the Pacific slope of

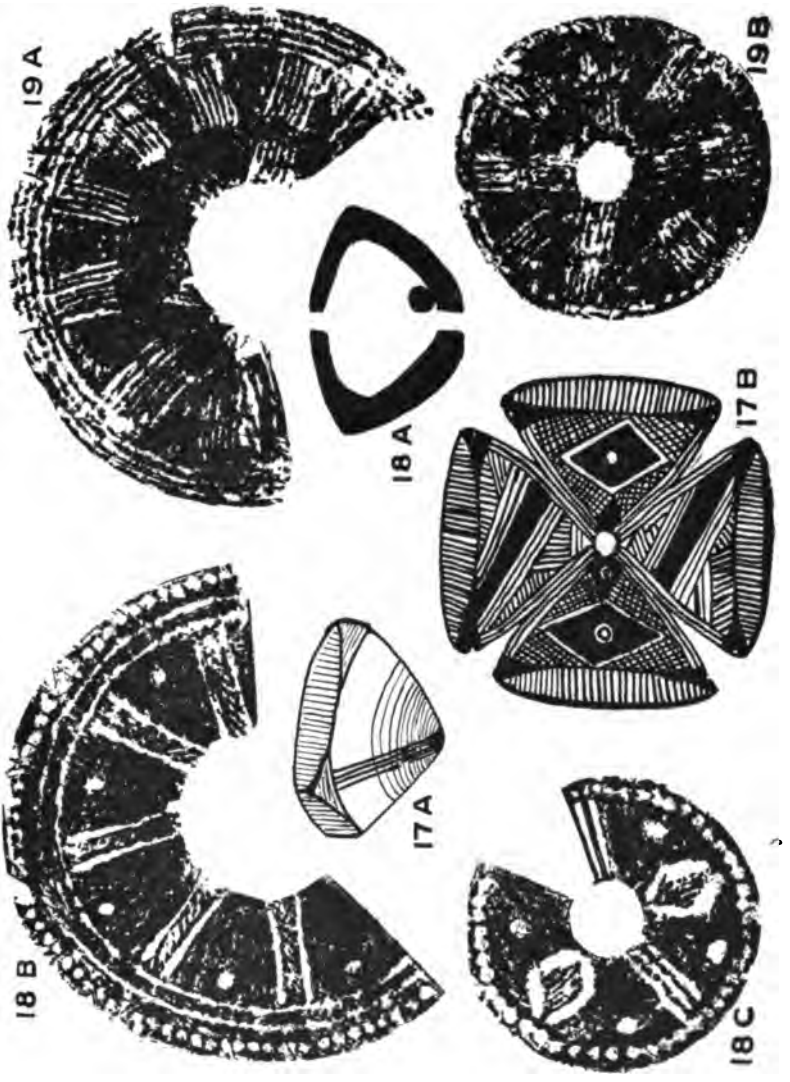

PLATE III.—SPINDLE WHORLS.

southern Mexico,* and there is every probablility that this was an ancient industry not confined to that locality. A careful microscopical examination of the fibre of the yarn showed it to be of animal nature. Two theories are available — one, that the wool of some species, llama or vicuña was anciently died and spun in Colombia, — the other, that the whorl picked up in the fields, was used by the modern housewife until rescued by the hand of the antiquarian.

The comparative study of the spindle whorls of North America attempted in the foregoing pages, puts forth no claim to be exhaustive in its scope, or final in its conclusions. All the older collections are depreciated by broad generalities regarding provenance, when indeed any data are available. Fresh information from the field archaeologist, together with the study of other collections, notably those of Boston and Chicago, the consideration of which, I regret to say, has not been possible as yet, will doubtless altar much of this provisional classification. The pioneer inevitably leaves many stumps in his clearing.

EXPLANATION OF PLATES.

PLATE I.

Fig.	1A.	A. N. S. 4205.	Pale brown; incised. (From a Rubbing.)
"	1B.	" " 4205.	Profile.
"	2.	" " (Poinsette Coll.)	Black, Mexican Type III.
"	3.	U. S. N. M. 196,674.	Brown, highly polished, Mexican Type II.
"	4.	" " 196,674.	Red, highly polished. Mexican Type II.
"	5.	" " 196,674.	–70. Grey. Mexican Type III
"	6.	A. N. S. (Poinsette Coll.)	Black, Mexican Type IV.
"	7A.	" " 4344.	Terra Cotta Spinning-Cup.
"	7B.	" " 4344.	Design.
"	8A.	" " 4179.	Incised, diagonal raised bands painted in black. Rubbing

* Prof. FREDERICK STARR. Loc. cit. p. 68. (By the Chontals.)

Fig. 8B.	A. N. S. 4179.	. .	Painted upper surface with incised and painted border.
" 8C.	" " 4179.	. .	Profile. Mexican Type I.
" 9A.	U. S. N. M. 155,295.	.	Dull grey. Mexican Type V
" 9B.	" " 155,295.	.	Cross section.
" 10	" " 197,110.	.	Brown. Metepec. Mexican Type VI.
" 11	A. M. N. H. .	. .	Dull grey. Ruins of Cempoalla (Totonacan.)
" 12	" "	stone.	Illinois.

PLATE II.

Fig. 14A.	A. N. S. 4183.	. .	Dark brown. Profile. Colombian Type II, Variety *b*.
" 14B.	" 4183.	. .	Upper surface. Rubbing.
" 14C.	" 4183.	. .	Lower surface, above the stem Rubbing.
" 15A.	" 4181.	. .	Upper surface. Rubbing.
" 15B.	" 4181.	. .	Incised border to lower surface above the stem. Rubbing
" 15C.	" 4181.	. .	Pattern incised on the stem. Rubbing.
" 16A.	" 4178.	. .	Cross section. Colombian Type I.
" 16B.	" 4178.	. .	Upper surface. Rubbing.
" 16C.	" 4178.	. .	Convex lower surface. Rubbing

PLATE LII.

Fig. 17A.	U. S. N. M. (6449)	195,570	Colombian Type III.
" 17B.	" " "	"	Ornamentat'n of lower surfaces
" 18A.	A. N. S. 4177.	. .	Cross section. Colombian Type IV.
" 18B.	" 4177.	. .	Convex lower surface. Rubbing
" 18C.	" 4177,	. .	Slightly convex upper surface Rubbing.
" 19A.	" 4173.	. .	Convex lower surface. Rubbing
" 19B.	" 4173,	. .	Flat upper surface.
Text Figure 13.	U. S. N. M. 195,571.	.	Colombian Type I, Variety *a*.

A. M. N. H.= American Museum of Natural History, New York.
A. N. S. = Academy of Natural Sciences, of Philadelphia.
U. S. N. M.= United States National Museum, Washington.

The expressions top and bottom, upper and lower surfaces, as used in this paper, refer to the position of the whorl when in use with the apex downward, not to its stable attitude in the museum case.

The PRESIDENT. The last paper on the programme, the Census of Cotton Spindles in the United States, consists of an authoritative of compilation of this important information which has been made at the request of the Secretary by the Bureau of the Census, and will be read by title.

NUMBER OF COTTON SPINDLES IN THE UNITED STATES.

C. J. H. WOODBURY, Boston, Mass.

There are many inquiries of the Association as to the actual number of spindles in this country, as the various commercial reports are widely different from each other. The following information have been furnished the Association by the Census Department. It is not known whether the cotton spindles previous to 1890 include those in woolen mills, but the presumption is that it does not. The cotton spindles were not enumerated in the census of 1830.

COTTON SPINDLES IN THE UNITED STATES.

1810	87,000	
1820	250,000	
1830	. . .	
1840	2,284,631	
1850	3,633,693	
1860	5,235,727	
1870	7,132,415	
1880	10,653,435	
1890	14,188,103	*14,550,323
1900	19,008,352	*19,472,232

* Including cotton spindles in woolen mills.

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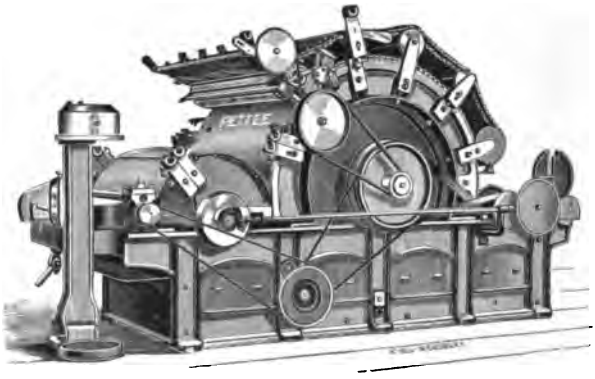

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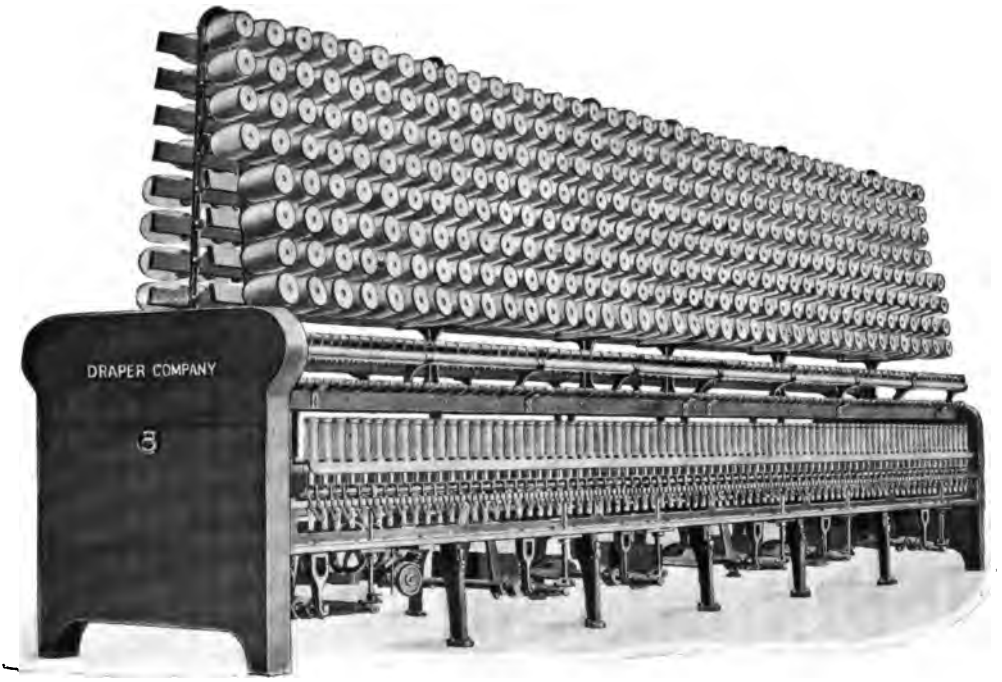

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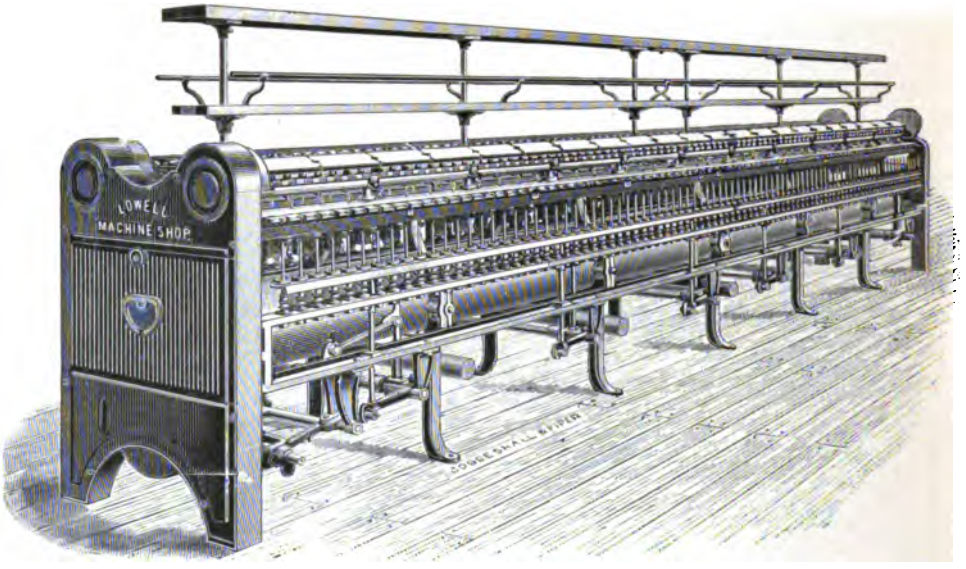

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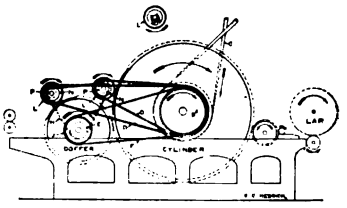

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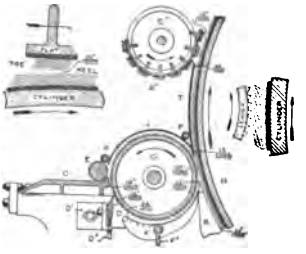

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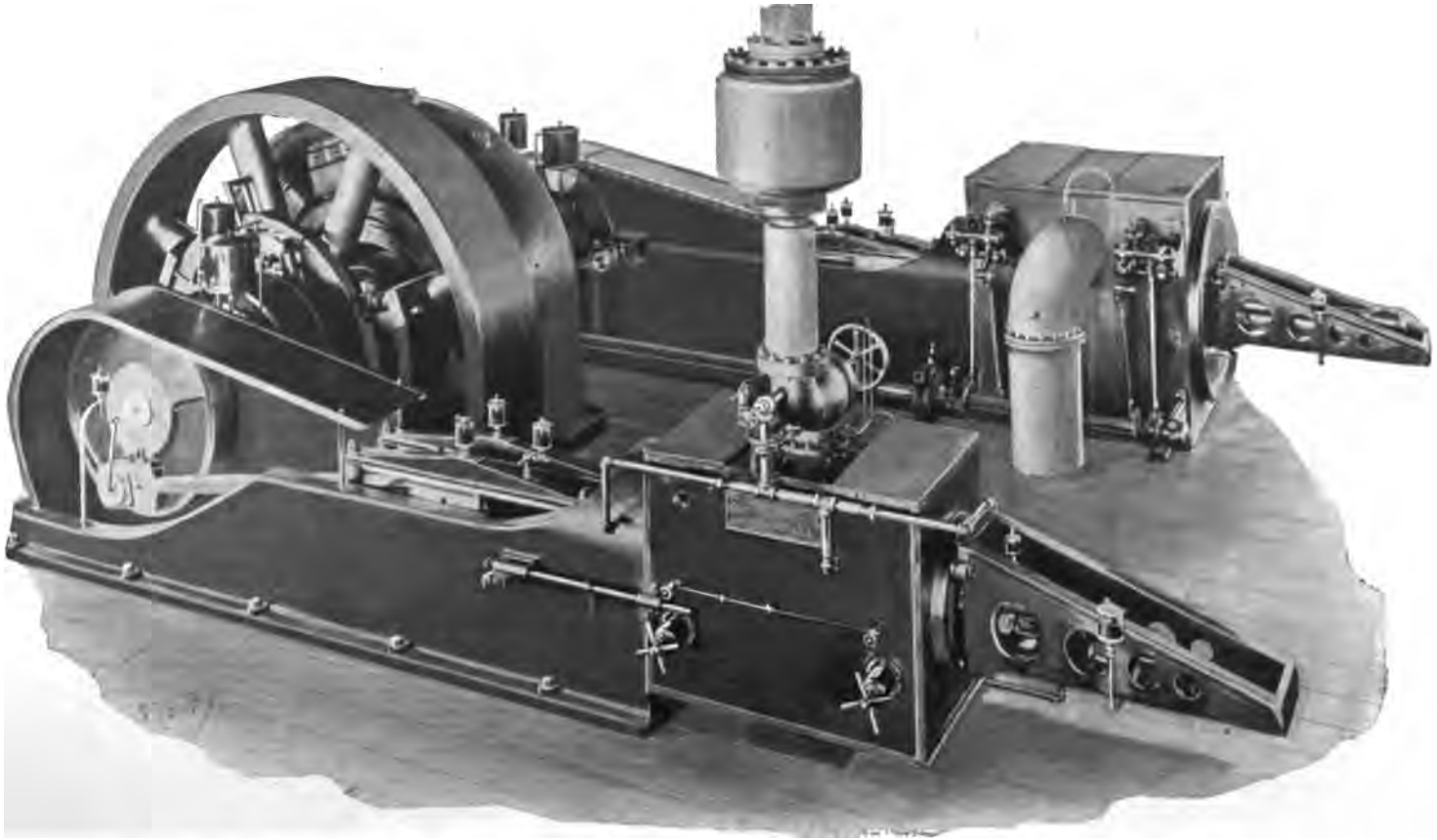

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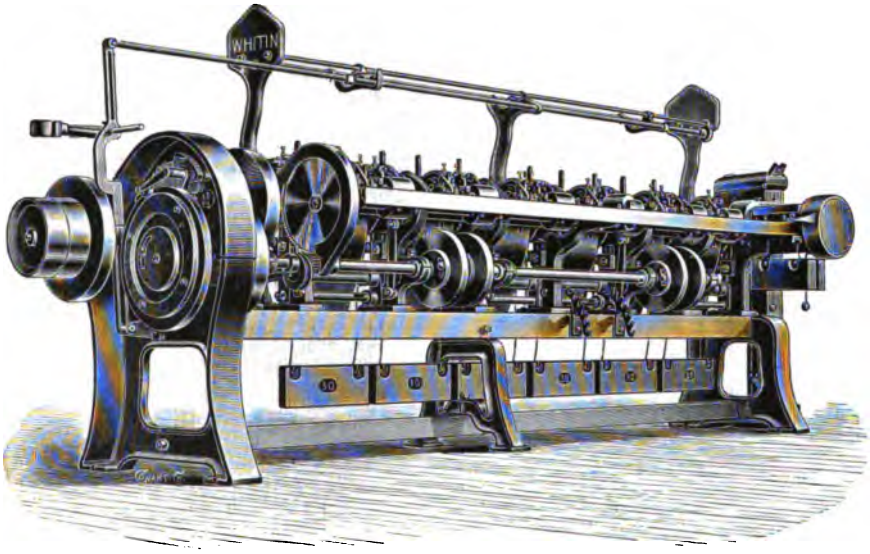

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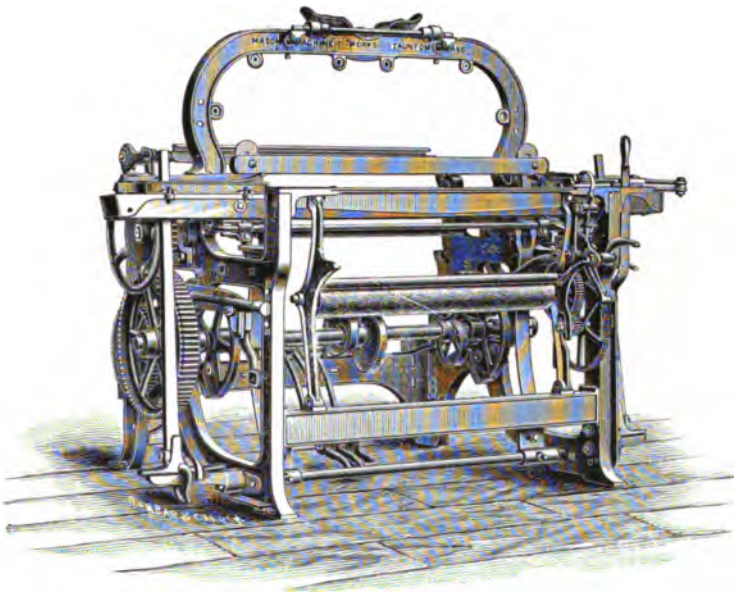

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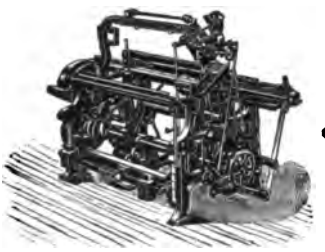

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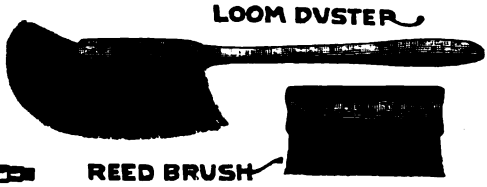

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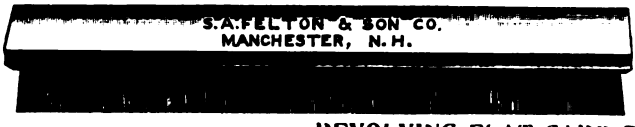
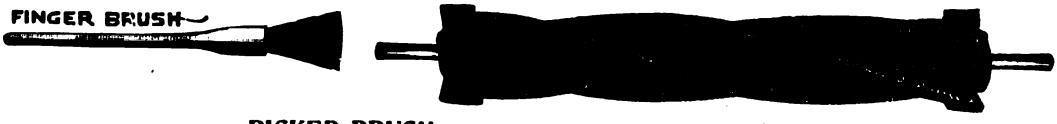


REVOLVING FLAT CARD BRUSH.

FINGER BRUSH.



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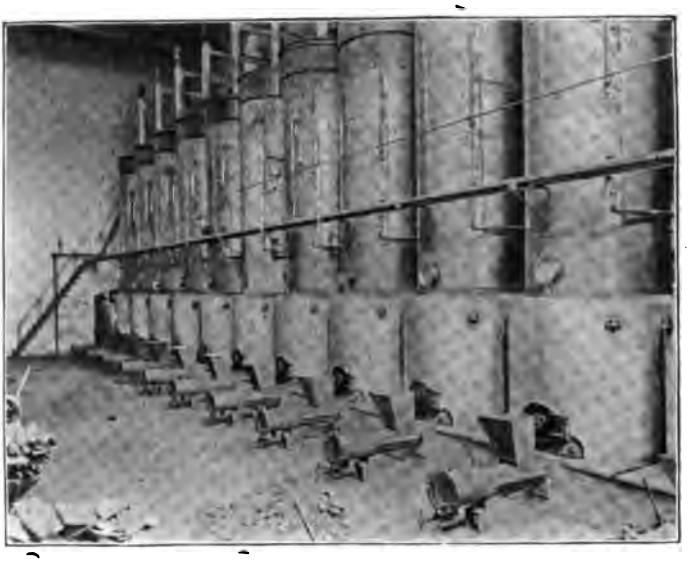

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